September 19, 1918 American Machinist Vol. 49, No. 12

Ancient Helmet Making

By
H. H. Manchester

One of the noticeable features of the war is the recrudescence of the helmet. This has tended to create interest in its past history, especially as all helmets now in use are probably patterned after one of the many styles developed when it was an essential feature of a warrior's armor.

THE helmet seems to have been first developed in Asia Minor about 5000 years ago. Possibly the oldest record of helmets is in the so-called "Stele of Victory" of Eannatum, Fig. 1., ruler of Lagash, in 2920 B.C. On this stele two separate panels portray the king leading his troops to victory. In the upper one he is on foot, and the soldiers are armed with long lances, giving them somewhat the appearance of a Macedonian phalanx. In the lower panel the king is riding in his chariot, which is one of the earliest representations of a wheel vehicle. Both scenes prove the use of helmets at that time. On the king's helmet may be seen ear pieces which are lacking on those worn by his soldiers. Another stele of victory, this one by Naram-Sin, ruler of Agate, about 2600 B.C., illustrates the use of horned helmets, one of which is very plainly pictured worn by the king. What material these almost prehistoric helmets were made of can be judged only from the sculptures themselves, but the earliest of them were probably made from the skins or even the skin-covered skulls of animals. If at first the upper part of the skull was used with the skin on it this would explain the appearance of horns in the helmet of Naram-Sin and the continued use of horns much later by barbarian tribes. There is in fact an archaic Greek picture of Hercules, or Herakles, wearing a lion skin, Fig. 2, where his head is entirely inclosed in that of the lion and his face appearing through the lion's mouth. The use of skin may have been followed by that of leather or other materials before the application of metal to this specific purpose. On the other hand the working of copper was known as early as the beginning of history, and there is no proof that the earliest helmets represented were not of this metal. In Egypt, nevertheless, though copper working was understood probably 6000 years ago, the helmets worn 3000 years later seem to have been made of heavy quilted material.

FIG. 1. ONE OF THE EARLIEST HELMETS, 2920 B. C.

Several pictures of the time of Rameses II illustrate soldiers protected by thickly wadded helmets. Occasionally the wadding was covered with metal plates, but these were more frequently employed on corselets. Later, of course, bronze helmets were introduced into Egypt as elsewhere, and Herodotus mentions that they were known there in the reign of Psammetichus. The home of the helmet, however, continued to be Asia Minor, and it probably had an unbroken history there from the days of Eannatum down. The Assyrian basreliefs, picturing battle scenes and attacks on fortresses, all prove the use of the helmet. Some are shown very plainly, for example, in bas-reliefs commemorating Sargon's assault on a walled city about 715 B.C.

The employment of bronze as material for helmets seems to have originated during the Assyrian era. There have in fact been preserved several bronze helmets of this period. One of these is simply conical and another is pointed at the top. Some are also shown with small crests and chin straps. There has even been discovered an Assyrian iron helmet; but though iron was used for spear points and swords it was seldom

employed for helmets. Both forging and casting of copper, bronze and iron were already known, and it is suggestive of the method whereby helmets were finished that files of bronze and iron dating from this period have been discovered.

The Persians likewise made constant use of the helmet. By this time cheek and chin pieces had come in, though they appear but rarely in pictures. There is also in evidence a Persian helmet with a movable plate, forming a visor, a method of construction which was a precursor of one adopted in the sixteenth century. Sometimes the Persian helmets were made with scales, such as were more often employed in the other armor of that race.

Considerable evidence of the employment of the helmet by the Greeks at the very beginning of their history is to be found in the Iliad. One striking fact is that skin or leather helmets were still in use side by side with bronze. One early Greek name for the helmet signified "dog skin," while another appellation was

FIG. 2. HERCULES IN THE LION'S SKIN

"weasel skin." Sometimes the leather basis was strengthened with bronze and ornamented with precious metals. Hector's helmet was of three layers, and like the other more elaborate Greek helmets had several crests of metal surmounted with horse-hair plumes.

The earliest actual statement concerning the making of a helmet is probably at the end of the eighteenth book of the Iliad in the description of how Hephaistos made the armor of Achilles. In this description it is interesting to find that Hephaistos' furnace was blown by 20 bellows. The method seems to have been first to cast a plate, beat it into shape with a hammer, decorate it with punch and chisel and smooth it with a file and sandstone. At the end of the elaborate description of the shield there is simply the statement "Vulcan also made for Achilles a strong helmet fitted to his temples, beautifully and variously ornamented, and on it placed a golden crest."

There are at least two ancient Greek pictures representing the making of this armor by Hephaistos. In one of these, Fig. 3, a furnace may be seen at the left, behind which appears one of the assistants who worked the bellows. In front of the furnace another workman is busy upon the helmet, the crest of which almost merges into the background of the picture. Although the original is partially destroyed from the position of his hand it is probable that he is using a hammer.

Another conception of the scene, Fig. 4, shows a workman at the left decorating the helmet. Here he is seated upon a low block and is working with a hammer and punch. Other paraphernalia which appear are a metal anvil on a wooden stock, tongs and various hammers. In this case the helmet is depicted with neck pieces and a crest. Achilles' helmet and shield were made of bronze. Steel, however, was known in epic times, for the Odyssey describes how "the axe hisses

FIG. 3. MAKING ACHILLES' ARMOR

loudly when some smith plunges it into cold water to temper it, for hence is the strength of iron."

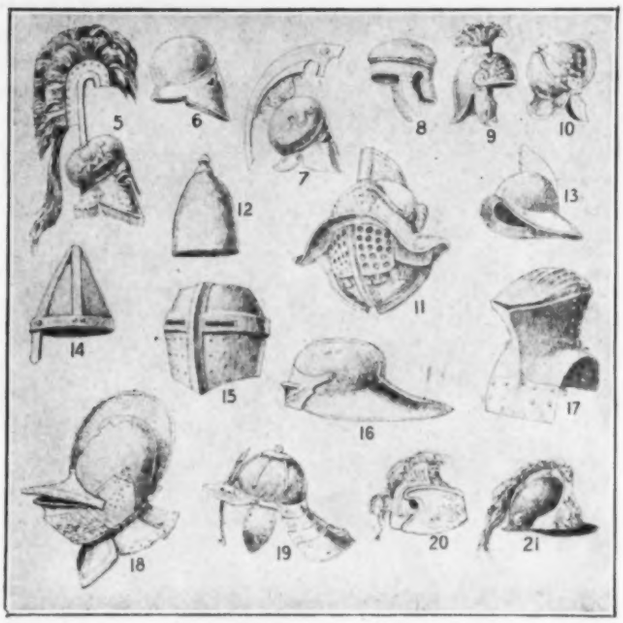
In Greek classic times the Corinthian helmets covered the face to the chin, but were often without plumes or crests. The Athenian helmets did not cover the face, but usually had cheek pieces and crests of metal with plumes of horse hair or feathers. The Spartan helmet was more often a plain metal cap without cheek pieces, crests or plumes. An Etruscan helmet which has been

FIG. 4. HELMET MAKING (FROM A GRÆCO-ROMAN PAINTING)

discovered is bell-shaped with projections somewhat resembling small wings.

The Romans were among the first to adopt iron or steel for weapons, but even when this was used regularly for offensive weapons defensive ones were still made of

bronze. Thus in the time of Polybius, at the end of the Punic Wars, when the Greeks still used bronze for swords and spears, the Romans were employing steel,



FIGS. 5 TO 21. HELMETS FROM GREEK TO MODERN TIMES

Figs. 5 to 7—Greek. Figs. 8 to 10—Roman. Fig. 11—Roman gladiatorial. Fig. 12—Teutonic (bronze). Fig. 13.—Carolingian. Fig. 14—Norman. Fig. 15—Thirteenth century. Fig. 16—Fifteenth century salade. Fig. 17—Fifteenth century. Fig. 18—Sixteenth century. Fig. 19—Seventeenth century. Fig. 20—English light dragoon, 1788. Fig. 21—Bavarian, 1790.

but at the same time still retained bronze for their helmets and shields.

Some of the Roman helmets had neck pieces without face pieces and some had both. Those worn by the

FIG. 22. A 13TH CENTURY ARMORER MAKING A HELMET

gladiators often entirely covered the face with a fixed visor which was pierced with small holes. On the common soldiers the monuments often show a plain, undecorated skull cap which was strengthened by cross-bands of iron. When on the march it was removed.

In making the Roman helmet both casting and forging seem to have been employed. In some cases the bronze was run into plain plates, which were beaten into shape for the various parts of the helmet, and these joined together afterward. The simpler forms of helmets, however, were probably roughly cast in the beginning. Several methods of casting had long been known, notably casting in clay and by the *cire perdue*, or lost-wax, process.

The Roman smith was of course supplied with bellows and anvils. Among his metal-working tools were hammers, punches, chisels and files. Grindstones had come into use and were employed for polishing and saws were made to work in metal by the use of sand or emery powder.

One point that should not be forgotten in connection with all manufacture in ancient Greece and Rome is

FIG. 23. A MEDIAEVAL ARMORER'S SHOP

that the work was done almost entirely by either slaves or freedmen. As a consequence, all such labor was looked down upon, and conditions were of the worst. Even after the decadence of slavery the metal worker under Diocletian received only about 20 cents a day at a time when wheat was approximately $2 a bushel, at which rates it would have taken him ten days to earn a bushel of wheat.

The barbarian tribes which swept over the Roman Empire often wore some sort of helmet. Thus there is a horned helmet accredited to the Germans and Scan-

dinavians, and a skull cap to the Anglo-Saxons. The Franks at first wore none, but under Charlemagne a triangular helmet is pictured on the heads of the household guard. At the time of William the Conqueror, the Normans, according to the Bayeux tapestry, wore conical helmets with a straight flap to protect the nose.

The so-called Dark Ages in Europe were the bright ones of the Mohammedan world, and during this period we find in the East a great advance made in the use of steel. This was carried by the Crusaders to western Europe, and both east and west developed the armor of the knight which completely covered him from head to toe. Thus for the first time the helmet emerged from the age of bronze to that of steel.

Armorers were in existence in Milan and Florence in the eleventh century, but armor was not strongly developed until 100 years later.

Many types of helmets appeared during the Middle Ages. In the twelfth century we find a rather crude one which covered the face with a solid piece. In the thirteenth century the crested helmet came in, which however was carried on the saddle and worn only in combat or at tournaments. Underneath the helmet was a mail hood which in turn was worn over a quilted cap.

In the thirteenth century also came in the bassinet. The small bassinet was a pointed helmet fitting closely

FIG. 24. MAXIMILLIAN IN SEYSENHOFER'S SHOP

like a skull cap. The large one had also cheek and neck pieces and sometimes a visor.

In the fourteenth century the great tilting helmet came into fashion. This weighed from 20 to 23 lb., while the one used in battle was only from 6 to 9 lb. in weight.

In the first part of the fifteenth century, the great bassinet was driven out of style by the salade. This had a guard for the neck, forehead and nose, but required a separate piece called a beaver to protect the mouth and chin.

The most perfect type of helmet was probably the armet. This was developed in 1450 and worn for two centuries. It had a visor, nosepiece and ventail, or fan, which were all movable and could be raised up to the crest by means of a pivot.

A simpler form of head protection was the iron hat, which had a brim, but neither visor nor neckguard, and was more or less in use from the twelfth to the

FIG. 25. AN ARMORER OF 1598

seventeenth century. The morion had a conical top but no brim, visor, nosepiece, gorget or neckguard. It was probably the direct ancestor of the helmets used today. Somewhat similar was the cabasset, which was so named from its resemblance in shape to a pear.

All of these helmets were regularly made of steel, but during the period between 1500 and 1560 bronze came back into use, largely because it was easier to keep clean. This was followed in turn by black armor which was ornamented with gold and silver damascening.

Figs. 5 to 21 give a pictorial sketch of the development of the helmet from Greek to modern times.

The manufacture of the helmet in medieval times is illustrated in several pictures of that period. One of the thirteenth century, Fig. 22, shows a smith hammering out a helmet. Another, Fig. 23, is taken from "The Book of Noble Ladies," and depicts the visit of some noblewomen to an armorer's shop.

Wire drawing was improved by Rudolph of Nuremberg about 1306, and from this time chain armor and the chain cap under the helmet were frequently worn.

One of the most important cities for the manufacture of armor was Milan. The industry was so far developed there that after the battle of Macalo in 1427 the Milan armorers supplied arms for 4000 cavalry and 2000 infantry within a few days' time.

A remarkably interesting engraving, Fig. 24, is the one by Burghmair showing the visit of Maximilian, emperor of the Holy Roman Empire, to the shop of Conrat Seysenhofer, the armorer who made for Henry VIII of England the suit which now hangs in the Tower of London. The arrangement of the bellows and forge are clearly shown, while a great variety of hammers, punches, chisels, files and other tools are displayed in the foreground. Of even greater interest are the large shears for cutting metal, which are shown fastened to a block of wood at the left of the picture. This is one of the earliest representations of such metal-cutting shears.

The emperor converses with the armorer and admonishes him not to use the forbidden art. It is not stated what this is, but one wonders whether casting is meant, as the casting of iron had been much developed in the previous century.

It is stated that Seysenhofer employed a new art for warriors' armor so that "in his workshop 30 front pieces and 30 hind pieces were made at once." Possibly this was some form of division of labor.

Another cut of an armorer's shop, Fig. 25, is that by Jost Ammon in 1568. Its chief interest is in showing the different kinds of helmets in vogue at that time.

A far more striking engraving, Fig. 26, is by Stradanus about 1570. It shows the polishing department, and proves that at this period grindstones were used for this purposes and that they were interconnected by a shaft. It is in fact one of the earliest representations of such a shaft arrangement, but whether the drum was turned by a waterwheel or by a treadwheel is not certain, for both forms of power were used at that date.

Furloughs for Skilled Laborers

Bernard M. Baruch, chairman of the War Industries Board, announces that the War Industries Board and the War Department will coöperate in determining furloughs from military service of skilled laborers and others engaged in important war work. The War Industries Board has appointed William M. Ritter of West Virginia as certifying officer representing the board in this work.

Mr. Ritter will be the point of contact between the War Industries Board and Darragh de Lancy of the Industrial Furloughs Section of the Adjutant General's Office in the War Department, through whom decision will be made as to the essentiality of certain men in war industry.

Heads of industries in war work who find that the draft is taking from them such of their skilled men as to reduce production of war material should apply to the War Industries Board for the furlough of these men. Commodity section chiefs in the board handling matters in connection with the industry alleged to be affected by the draft will make investigations as to the needs and conditions before acting on the requests for furloughs coming to them, and will then report to Mr. Ritter.

Men furloughed from military service on the recommendations of Mr. Ritter as Certifying Officer for the War Industries Board, will be instructed to report to the industry applying for their furlough, and that industry will be required to make regular monthly reports to the certifying officer showing the continuance of the furloughed men in their employ.

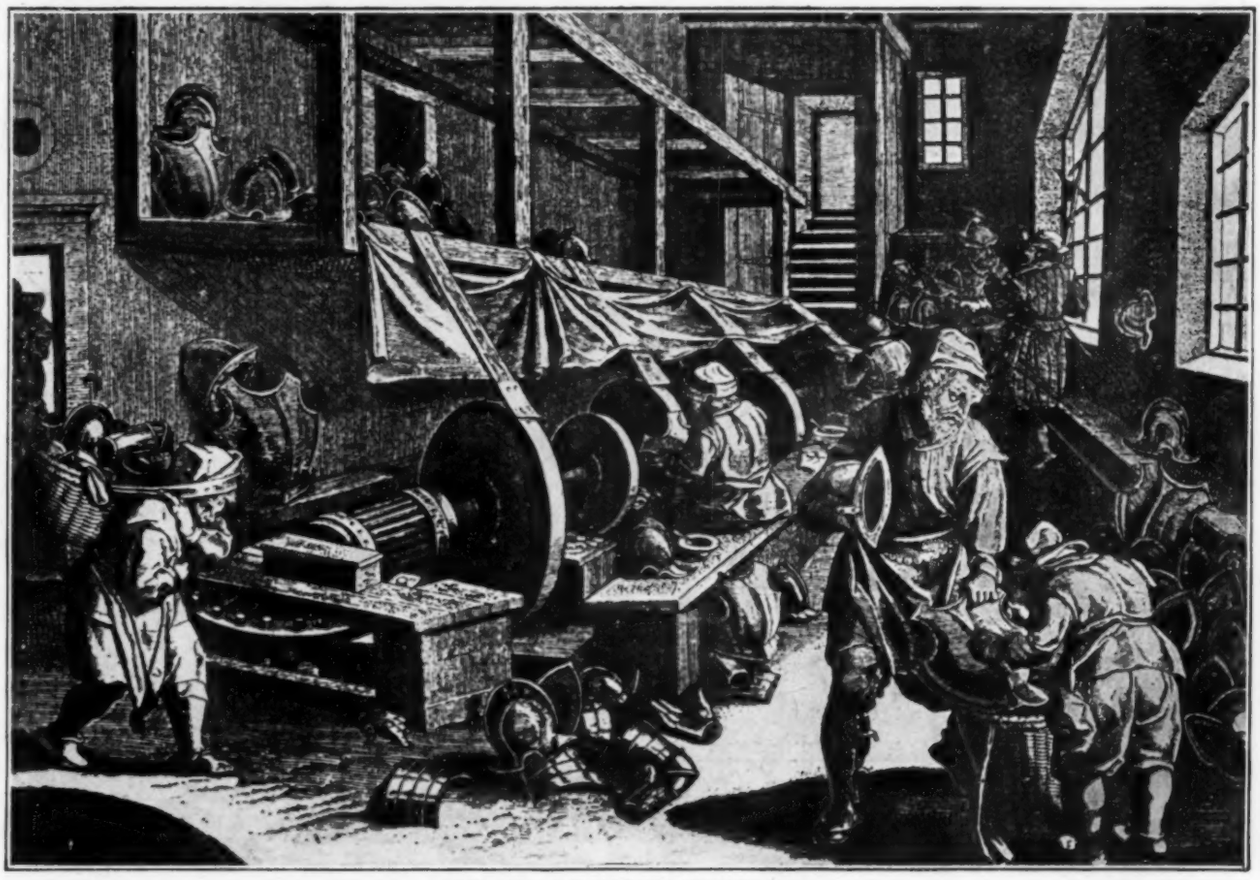


FIG. 26. POLISHING ARMOR, 1570

Double-Movement Dies for Bulldozer Work

BY J. V. HUNTER
Western Editor *American Machinist*

The bulldozer, a machine common in large forge shops for bending and forming pieces too large to be conveniently worked by hand, can be used on a wide range of operations by means of a few easily and cheaply made sets of dies.

ALTHOUGH the only movement provided by a standard bending machine, or bulldozer, for forge-shop work is reciprocating, the work that can be done upon this machine is by no means limited to parts that can be made by this single motion, as many methods have been worked out for introducing other movements applicable to different classes of work by

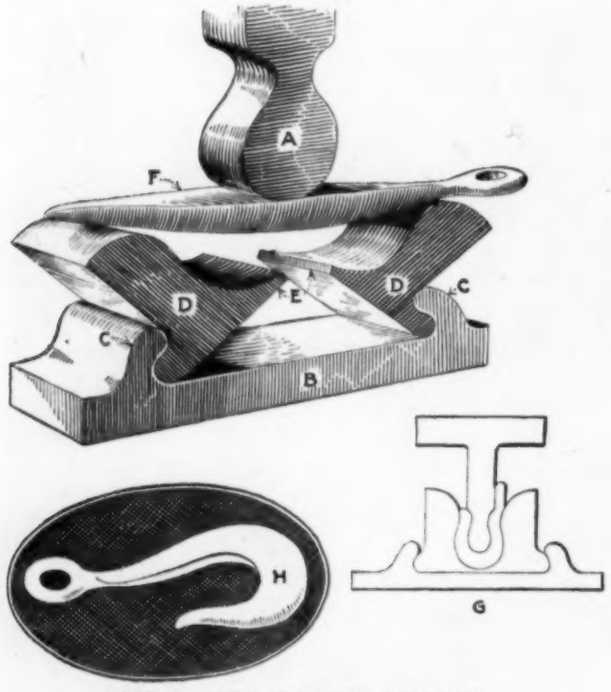


FIG. 1. DIES FOR BENDING HOOK

means of dies with moving parts operated by the slide of the machine, and some interesting results have been attained.

While this extra movement is usually incorporated in the die, devices are sometimes built on the machine itself in order that it may be used on a series of operations.

The two-movement die usually involves one of three mechanical principles—the wedge, the swinging arm, or gearing (rack and pinion)—and their relative importance are in about that order. A die of the second class is shown in Fig. 1. It is used for bending up a chain hook, the body of which has previously been forged to shape in a straight length. With heavy hooks the operation of bending by hand would require considerable time, while with these dies it is a matter of seconds. The dies are quite simple, the punch *A* consisting of a plunger fitting the inside of the hook.

The die consists of a body *B* which is provided with the sockets *C* at each side. The forming blocks *D* are fitted in such a manner as to permit partial rotation in the sockets when pressure is brought to bear upon the points *E* through the medium of the work *F*. The inner contour of the blocks *D* is fitted to the completed hook as shown at *G*. In operation the forging *F* is laid in position across the blocks as indicated, and when the punch comes forward the hot metal is pushed into the die until it comes in contact with the points *E*. Further

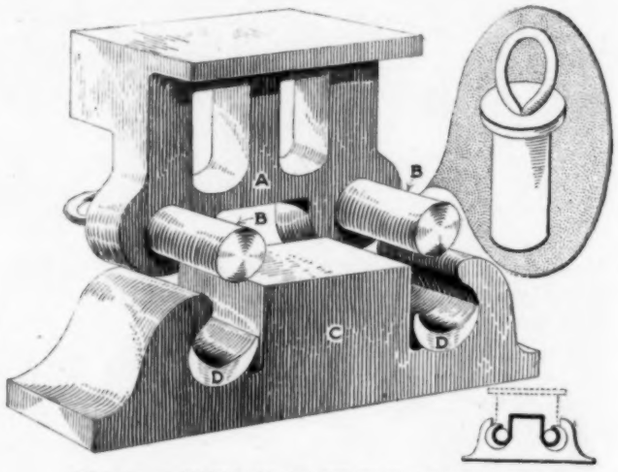


FIG. 2. DOUBLE-MOVEMENT FORMING DIE

movement of punch and forging causes the blocks *D* to close in, folding the hook closely about the punch. The punch is then withdrawn, the blocks open and the completed hook may be pushed off the punch.

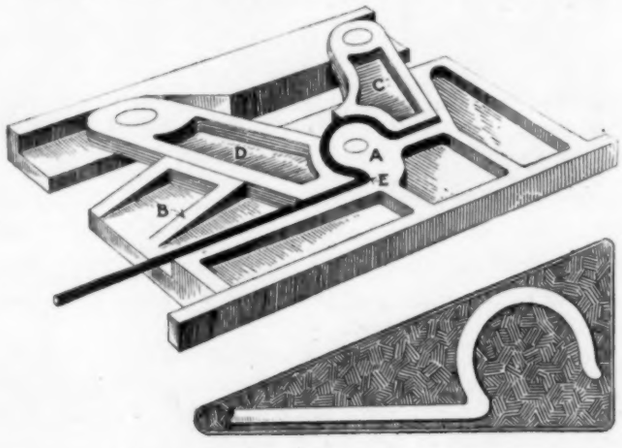


FIG. 3. TYPE OF SWINGING-ARM DIE

A more complicated form of die employing the same general principle is shown in Fig. 2, the forging being shown to the right. The main body of the punch *A* is of sufficient weight and strength to adequately support the pins *B* which are a slip fit in the body. Rings in the tops of the pins furnish a convenient means of withdrawing them to release the completed forging.

The die *C* has two sockets which are carefully bored out and fitted with the movable pieces *D*. The operation

of the die is clearly shown in the figure. When the punch moves forward only the pins *B* come in contact with the work, which is folded over the corners of the die and into the pockets. As the pressure comes upon

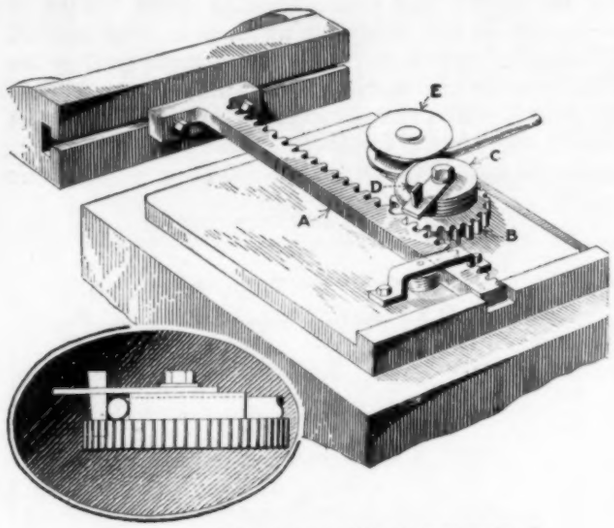


FIG. 4. RACK-AND-PINION MOVEMENT

the upturned corners of the movable parts *D*, the latter are partially rotated to the position shown at the right, at which point the machine is stopped and the pins withdrawn, when the punch is allowed to move back and the forging is pushed out of the die.

The swinging-arm type of die construction illustrated in Fig. 3 is for the purpose of bending the hook shown in the die. The rod is laid across the die *A* inside of the arm guide *B*, which is cut away to accommodate it. As the die closes the arm *C* forms part of the loop, while the arm *D* finishes the remainder and makes the bend at *E*.

An entirely different type of movement is shown in Fig. 4. This is not intended to represent the making of any particular manufactured part, but merely to give an idea of the method. The rack is attached to the moving head of the machine with its outer end supported by the roller mounted upon the die. The rack

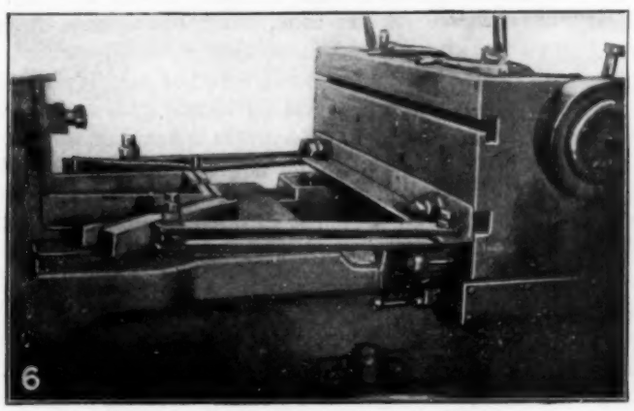


FIG. 6. THE DIE PARTIALLY CLOSED

A engages with the pinion *B*, causing the latter to revolve. On the hub of the pinion is the circular form *C*, to which one end of the rod is clamped by the wedge *D*. Movement of the machine slide causes the pinion to revolve to the position shown, during which movement the rod is wrapped around the form by the grooved guide roller *E*. When the stroke is completed the rod is disengaged from the clamp and lifted off the die. The best form of swinging-arm die construction is that illustrated in Fig. 5, not only from the standpoint of simplicity but from the wide range of forms to which it may be adapted and the readiness with which it may be set up and operated. The lengths of piece which may be bent is not limited by the width of the die, nor has the latter any tendency to throw the bars out of place before or during the bending operation.

The forming die *A* has a groove *B* in which the bar *C* is placed. When the operation starts the arms *D* pivoted at one end are swung against the bar and cause it to close up against the form. The arms *D* are moved

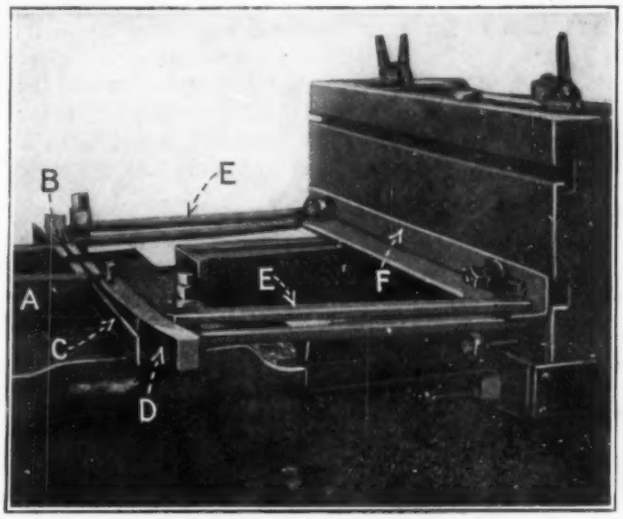


FIG. 5. IMPROVED FORM OF SWINGING-ARM DIE

by the connecting bars *E* which are pivoted to lugs on the back side of *D*, the other ends being connected to the cross-piece *F* which is in turn fastened to the moving head of the bulldozer. A better idea of this die can be obtained from Figs. 6 and 7, the former showing the die half closed and the latter the operation completed.

In the die shown the length of the connections *E*

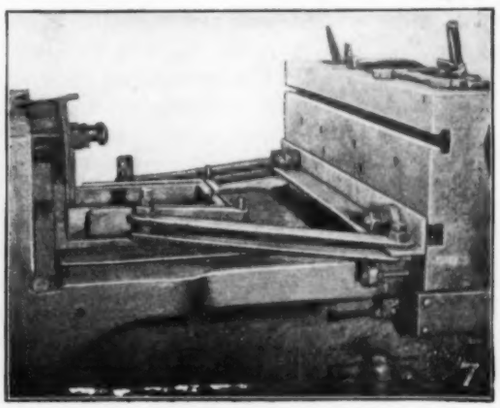


FIG. 7. THE STROKE COMPLETED

must be carefully calculated in relation to the movement of the ram. If the proportions of the piece to be bent are such that the full movement of the ram cannot be used compensation may be made for this excess movement by slotting the connecting-rods as in Fig. 8.

A die involving the wedge principle is shown in Fig. 9, and is used for the purpose of upsetting the ends of bars.

The faces of the jaws *A* are fitted to the stock to be upset, including the size and form of the upset portion. One of these dies is fixed in position on the body of the device, while the other is keyed to the movable arm *B*. Attached to the slide is the piece *C* carrying the punch *D* and the wedge *E*. As the head of the machine moves forward the wedge enters the space between the movable arm and the roller *F*, closing the dies together and gripping the bar held between them. Further advance of the punch upsets the rod and causes the heated metal to conform to the shape of the dies.

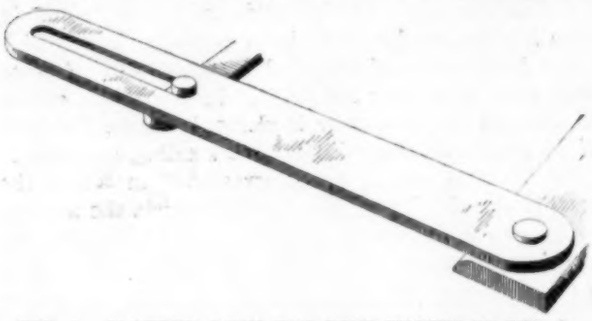


FIG. 8. SLOTTED LINK FOR DIES SHOWN IN FIG. 5.

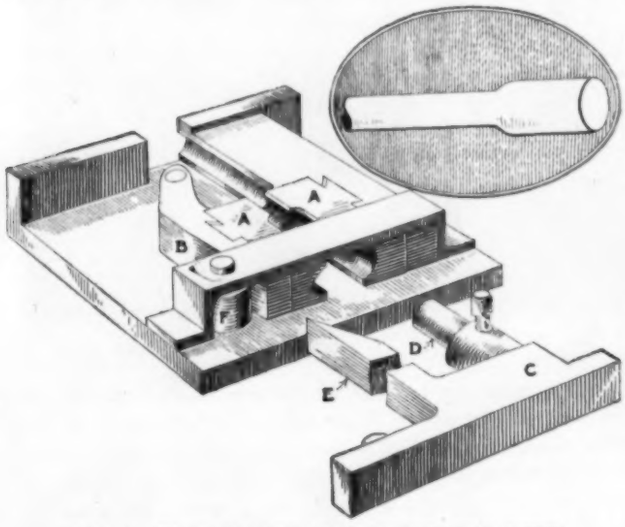


FIG. 9. WEDGE-OPERATED UPSETTING DIES

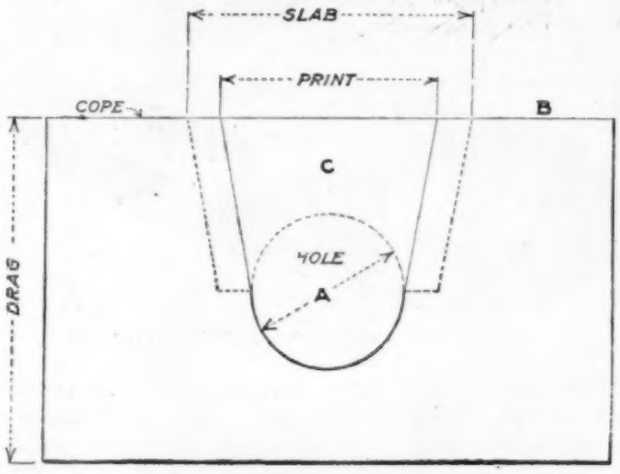
How Would You Make This Casting?

BY M. E. DUGGAN

On page 84 of the *American Machinist* John Compo describes his method for producing the casting in question in quantities. His method is a good one; in fact, it is the best I know for producing this difficult casting *in quantities*. But quantity is not to be considered in this question—speed, that's all you hear, from the master mechanic's office down through the various departments until the repair is made and the damaged machine is again started. You first make the repair and then do your thinking afterward.

There are no hard and fast rules governing the construction of patterns or the making of molds. The man who knows the short cuts in both trades is a valuable man when a breakdown occurs.

Some time ago I read an article in one of the technical magazines describing the dovetail print, the core box and the core. The sketch showed a plain casting, 8 in. square, in the middle of which is a cored hole *A*, *B* being the cope face. In order to avoid cutting the drag down to the center of the print you would just run two dovetail prints *C* up to the cope line and make a plain flat parting for the molder. The article went on to tell how the core box should be made, but this casting can be produced without a core box by making *A* and *C* from stock cores, the method being a practical one and in common use. When but one or two castings are required, the making of core boxes is a waste of time, and this is often the reason why patterns for a one-casting job are so costly.



CORING WITHOUT A CORE BOX

Marking Wood Patterns for the Purpose Of Identification

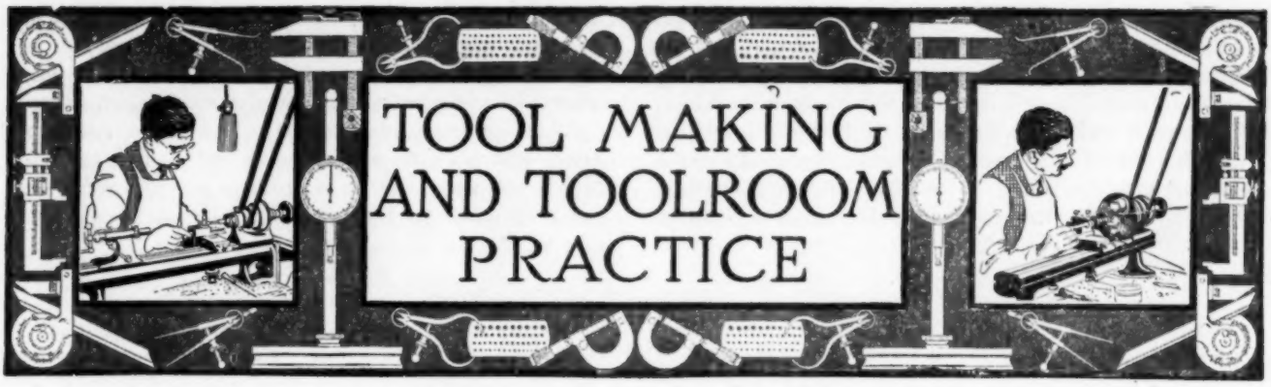
BY A. F. MILLER

I have given quite a bit of study to the marking of wooden patterns that are sent to the foundry, and have arrived at the conclusion that I have found a new and cheap way of marking.

I had three common rubber stamps made with the company's name on them in letters ⅛, ¼ and ½ in. in size and also bought a common black inking pad.

After the pattern is finished and sandpapered, stamp an impression on the pattern in any convenient place, then take common white marking chalk and rub it all around the impression. Gently smooth the chalk over the impression with the finger until it is entirely covered (this prevents smudging the impression when shellacking), then apply a coat of yellow shellac over the impression. Be sure to use only one stroke of the brush, as more might cause the ink to spread. After this has dried apply as many more coats as the pattern requires, usually one more. The pattern can now be shellacked all over with black shellac, painting around the impression.

This makes a very clear, cheap and lasting marking, and has all the other methods that I have seen beaten 50 ways.



Elements of Gagemaking—VI*

By C. A. MACREADY

The amount and trend of the distortion caused by grinding wheels is indefinite and is such that it can be predetermined to a limited extent only. The experienced gagemaker, or grinder hand, can detect a slight variation in the sound of the wheel at work, and this difference in sound informs him that distortion is taking place which will result in a change in the relative positions of holes and surfaces. These errors can be discovered and located by using one or more reference surfaces, and if not too pronounced can be corrected.

REFERENCE surfaces are preferably those that are ground to produce temporary locating surfaces, or work seats. The distortion of these work seats, due to grinding, has been corrected by lapping, and as their surfaces are generally smooth their accuracy can be tested with a knife-edge square or straightedge.

There are many different conditions that will cause the wheel to overheat the surface of the work, even when flooded with a cooling solution. A perfectly sharp wheel becomes partly dulled the moment the abrasive causes a red-hot spark. This dulling increases very rapidly up to the point where the friction of the cut is greater than the strength of the bond that holds the abrasive. The dull grains then are detached, and it is the general belief that this results in a resharpened wheel. To a certain extent it is true that this dislodgment of the dulled grains exposes sharper grains which thus become the cutting points. These grains have of course been doing a little cutting, but not enough to become so dull that they are dislodged. They are, however, not keenly sharp and become duller with use. This makes it desirable to use a wheel so bonded that it will readily shed the dulled grains. The grains of the abrasive wheel should be as coarse as possible and still produce the required finish.

This general statement of the cause of dullness is also applicable to the means used to sharpen the wheel. A perfectly sharp diamond will give good results. But the surface produced by a sharp diamond is not an ideal cutting surface as the grains of the abrasive are flat instead of pointed, because the sharp diamond, to a certain extent, cuts the grain before it fractures at its back edge. A perfectly sharp diamond begins to dull as soon as it is passed under an abrasive wheel revolving at the speed recommended by the wheel makers. A diamond to remain sharp as long as possible should be used when the wheel is running slow. This slow speed can be attained by pulling the belt by hand. After the wheel is retrued in this way the diamond should be left in the position occupied during the last cut, the machine started up full speed and the diamond passed across the wheel to correct errors due to the wheel running out of balance. This does not amount to much if the bearings are properly adjusted. In this way the diamond is used at high speed for the least amount of time, and there is little wear on its sharp edge. This leaves the cutting points of the abrasive in the wheel in the best possible condition obtainable with a diamond.

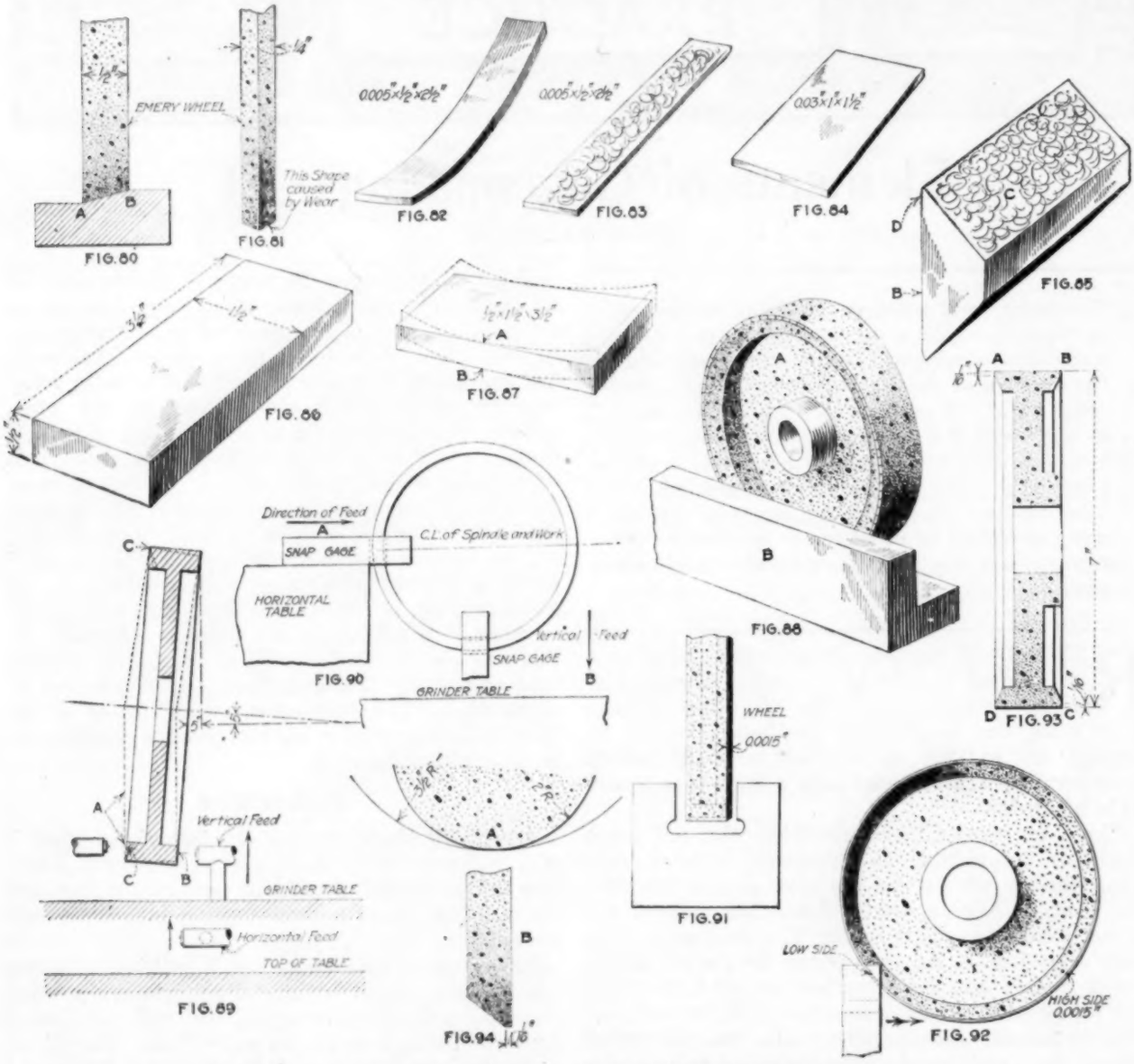
Surface Heat

A perfectly sharp wheel, if the face of the wheel is wide, will generate too much heat on thin work. These two conditions—dull wheel and too broad a face—are the ones that generally create surface heat that causes distortion.

If Figs. 80 and 81 be studied, it will be understood why the dislodgment of the dull grain fails to entirely resharpen a wheel having a soft bond, and why a broad face wheel will generate too much heat. We will assume that the difference in depth of cut between *A* and *B*, in Fig. 80, is 0.0005 in. This beveled face of the wheel has been produced by the dislodgment of dull grains. It is evident that there will be a division of this 0.0005 in. in depth of cut equally among the cutting grains. The result will be that practically all of these grains must become dull enough before they are dislodged by the friction of the cut. Before this happens there will be enough heat generated by the partly dulled grains to expand the surface that is being ground; this of course increases the depth of cut and often spoils the gage. If a comparatively narrow-faced wheel, as shown in Fig. 81, is used with feed alternately in each direction the generation of excess heat will be greatly modified.

*Prepared for the author's forthcoming book on gagemaking.

To the beginner, grinding a piece of steel 0.005 in. thick will be an impossible job until he learns to correct the distortions set up by the grinding shown in Fig. 82. The fancy frosted surface, shown in Fig. 83, is merely incidental to the process of correcting, which is carried out with a piece of India oilstone and has a distorting effect opposite to that of the abrasive wheel on the work. The frosting gives a surface that is pleasing is then stoned enough to bring the surface to a plane. The India stone can be used upon the work during grinding to reduce the concave curl that takes place in all work, and especially on slender work when ground on a surface-grinding machine. The India stone influences the work to a greater extent if the metal is thin. It results in saving many thin pieces from being ground too thin on their edges. The edges will curl



FIGS. 80 TO 94. VARIOUS PROBLEMS THAT CONFRONT THE GAGEMAKER

Figs. 80 and 81—Why the dislodgement of the dull grains fails to entirely resharpen a wheel. Fig. 82—How grinding distorts a thin piece. Fig. 83—Correcting distortion in a thin piece. Fig. 84—A piece for showing the effects of an India stone. Fig. 85—An angular piece of work. Fig. 86—The effect of peening. Fig. 87—Distortion due to grinding. Fig. 88—How a grinding wheel is nicked. Fig. 89—The effect of having the spindle at an angle. Fig. 90—How an untrue wheel grinds. Fig. 91—A wheel out of alignment. Fig. 92—Depth of cut for a wheel out of alignment. Fig. 93—A T-wheel. Fig. 94—Wheel with narrow edge.

to the eye, but the amount of metal removed from the surface is so little that it cannot be measured with a micrometer. A piece of hardened steel of the dimensions given in Fig. 84 will readily show the effects that can be caused by the use of India stone. This piece of steel can be reduced in thickness as test cuts are taken. The thinner it becomes the more pronounced are the effect of the wheel and the India stone.

The first stoning should be on the concave side of the work and should be carried on until the opposite surface becomes concave. This opposite concave surface away from the chuck, and it is evident that they must have at least a little strength to resist the wheel forcing them down to the face of the magnetic chuck. This resistance being great enough to raise the edges from the chuck allows the grinding wheel to remove more metal from the edges.

As previously stated curl takes place in all work being ground on a surface-grinding machine. In Fig. 85 an angular piece is illustrated. After the surface *C* is ground, if the surface *B* is tested with a knife-edge straightedge, it will be found in a curved

condition that starts at about the point *D*. If this curl is not too pronounced the surface *B* can be reduced to the original position if the oilstone is used in about the position illustrated, using a firm pressure upon the stone. On pieces too thick for the oilstone to affect them, peening with a light hammer will produce the same effect as the oilstone. In Fig. 86 is illustrated how some pieces have to be peened to put counter stresses in a piece that curls excessively when being ground. This example of peening is also used to illustrate the fallacy that a dull or loaded abrasive wheel has a peening effect. Ninety-nine times out of a hundred such a wheel will heat the surface it is grinding and make it concave. This is directly opposite to what the effects would be if it were peening the surface; that is, the surface would be convex.

The use of the peening hammer is a necessity, and if used judiciously will correct curl in the metal. An erroneous idea entertained by some is that it creates excessive stresses. The idea is that peening will cause the surface to continue moving for a long time, but this is not the case.

One should remember that this peening simply counteracts the unavoidable stresses induced by the heat from the grinding wheel. Peening merely sets up counter stresses to correct the grinding stresses that time will not correct. The peening stresses and grinding stresses can be made to balance each other so that the piece of hardened steel will be permanent. As an example of the balancing of these strains, the dotted line in Fig. 87 illustrates (exaggeratedly) a piece as it comes from the magnetic chuck. The surfaces *A* and *B* are parallel. The surface *A* is peened enough to straighten the piece, as shown by the full lines. If the surface *B* is now ground it will not curl any more than the surface *A* did before it was peened. This shows that the stretching action caused by peening the surface *A* is balanced by the grinding stresses in surface *A*, for as the piece is thinner, being weakened by the amount ground off the surface *B* if there was an excess of stress caused by the peening, the surface *B* would have an excessive curl as the heat strains are added to the peening strains. There is another unavoidable error caused by the heat from the grinding wheel. On work strong enough to resist the curling mentioned it will be discovered with a knife-edge straightedge that the center is low. This error, if objectionable, is corrected on a surface lap.

Grinding With the Side of a Wheel

There are conditions that require that the side of the wheel be used to finish surfaces. In these cases the sound of the wheel will denote its cutting qualities. This sound, if metallic in tone, indicates that the wheel has too deep a cut or that the wheel is dull. A soft bond wheel that is perfectly sharp will produce sparks almost noiselessly or with a tone that has no sharp ring. Once known the metallic ring will always be recognized. The difference between the surfaces produced by sharp and dull wheels will be readily apparent when they are tested with a straightedge.

There will be an excessive amount of friction if a loaded wheel is used to grind metal held by a magnetic chuck. The particles of metal in the wheel are to a certain extent attracted by the chuck. Loading occurs frequently on side-cutting wheels that have an excessively hard bond. The loose metal is forced into the spaces between the grains of the abrasive. There being so much of the surface of the wheel in contact with the work the chips and dust are compelled to remain between the wheel and work. This confinement can be partly reduced by nicking the sides of the wheel, as shown in Fig. 88, which illustrates at *A* one side of a T-wheel and at *B* the work. The nicks are filed in and spaced by guess.

Axis of Spindle Out of Square

A study of the layout in Fig. 89 will show that the axis of the spindle, if anything but square to the longitudinal travel of the table of the machine, will produce a cone-shaped surface when the sides of the wheel are trued. One side will be concave and the other convex, as shown by the dotted lines.

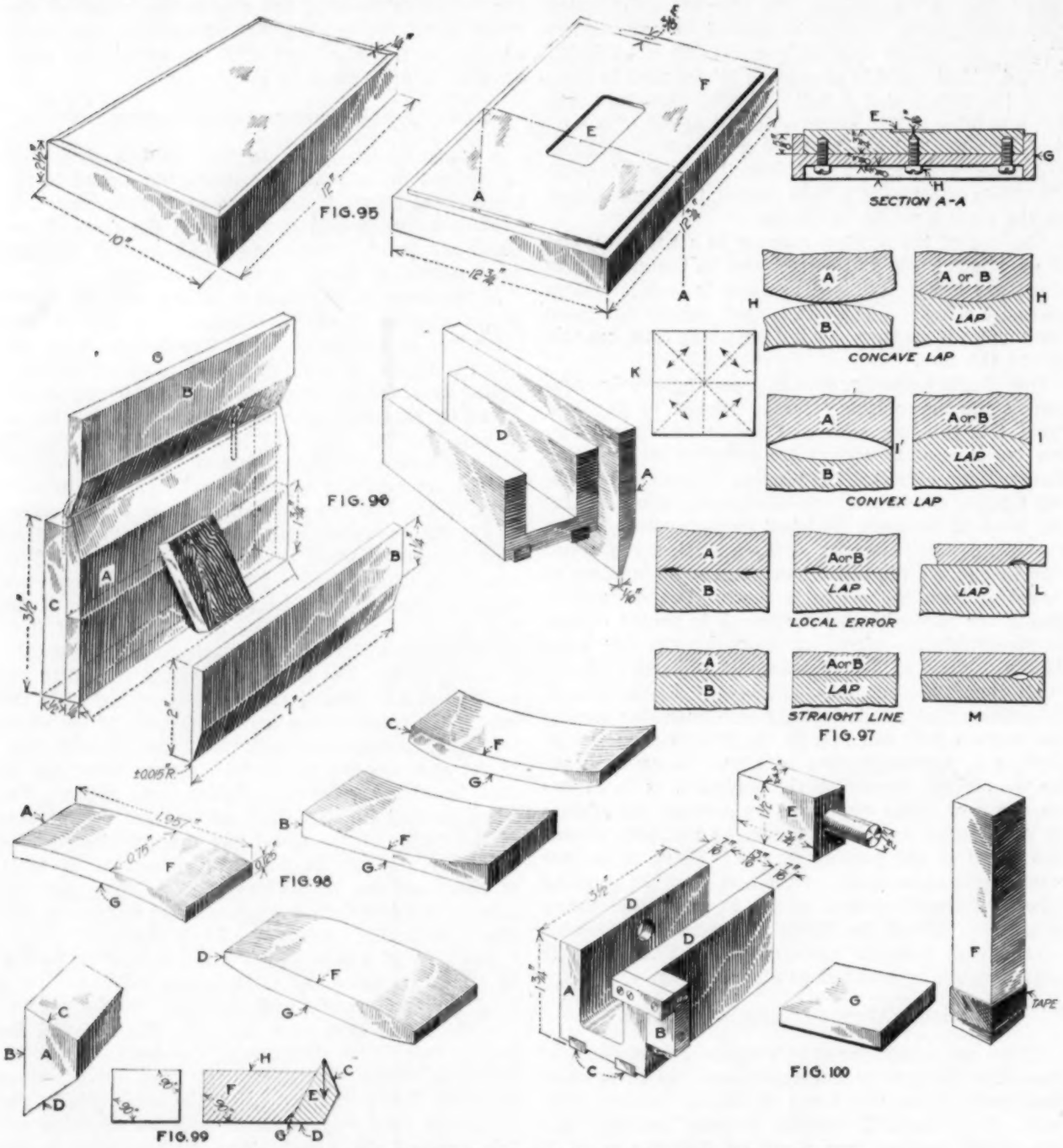
If the center of the work is in line with the center of the machine spindle, as illustrated in Fig. 90, and the wheel is left just as the diamond trues it, the wheel will grind a cylindrical surface of an unknown radius when fed in the direction of the arrows *A* and *B* in Fig. 90, using the side *A* of the wheel illustrated in Fig. 89. The other side of the wheel *B* in Fig. 89 will also make a concave surface of an unknown radius. As the sides of the wheel must be parallel to each other if trued at the same setting, the wheel surface *A*, Fig. 89, in contact with the work is a vertical line. This amount of wheel surface is too great to afford a cool cut. This is relieved by using the diamond free hand, as shown by the dotted lines at *C*. This is the best shape to which a wheel can be formed if it is out of square with the machine spindle either vertically or horizontally. The diamond is placed central to the work when a horizontal table is used, or central to the axis of the spindle when truing the sides of the wheel vertically, feeding down with the graduated handwheel. If not excessive the horizontal sideways error can be used to advantage when grinding snap gages. The wheel passing through the gage will cut on one side of the center of the wheel and the opposite edge of the other side of the wheel. The amount of error of alignment can be used to gage the roughing side cuts on surface-grinding machines that have no graduated dials on the cross-feed. As an example:

The view of a gage with a wheel in position in Fig. 91 shows the wheel out of alignment 0.0015 in. If a light contact is made with the gage on the edge of the wheel that is marked low side, Fig. 92, and the gage moved in the direction of the double arrow, the high side of the wheel's edge will have approximately 0.0015-in. depth of cut. Using the other side of the wheel the same way of course reverses the high and low sides of the wheel's edges with relation to the spindle center.

A side-cutting wheel called a T-wheel should be used wherever possible. In Fig. 93 is illustrated the cross-section of such a wheel. It will be noticed that the sides are undercut, or relieved, shown at *A*, *B*, *C* and *D*. This practically makes a saucer wheel out of a T-wheel when grinding slots and snap gages. It has a great advantage over the saucer wheel, as it is not necessary to reverse the wheel when grinding opposite surfaces. Most snap gages are thin enough for the

jaw of the gage to pass into the recess below the edge of a T-wheel. So if the high side of both sides of the wheel are used for finishing the gage, and the wheel throws a spark without the sharp metallic sound previously referred to, the ground surfaces should be in such a condition that very little lapping will be necessary to correct the errors that have been introduced by grinding.

The nicked wheel illustrated in Fig. 88 is not necessary on narrow-jawed snap gages, but nicks should be used in wheels for long, deep slots. These side-cutting wheels should be a couple of grades softer than wheels used for flat-surface grinding. When the choice rests between a wheel that is a little soft and one that is a little hard the soft wheel should be selected. There is a depth of cut that the soft wheel will stand up to, but there is no cut that the hard wheel can take without the always present danger of loading and spoiling the work.



FIGS. 95 TO 100. VARIOUS KINKS FOR LAPPING GAGES AND OTHER WORK

Fig. 95—A lap that stands up well. Fig. 96—Lapping a knife edge. Fig. 97—Method of detecting errors in lapping. Fig. 98—Method of correcting lapping errors. Fig. 99—The distorting effect of lapping an angular piece. Fig. 100—A lapping fixture and a method of lapping ends of long pieces.

The area of surface and thickness of the piece to be ground should determine the diameter of the wheel to be used. In Fig. 94 there is illustrated at *A* the difference between the surface contact of a wheel 4 in. and one 7 in. in diameter. A trial will easily demonstrate that the 7-in. wheel will so distort a thin piece that it will curl and not be retained even upon a

powerful magnetic chuck; this will be the case even if the face is reduced to an edge $\frac{1}{16}$ in. or less in width, as shown at *B*, Fig. 94. The smallest wheel that a B. & S. No. 2 surface-grinding machine can use with the wheel guard on is about 4 in. in diameter. With the face of the small wheel reduced to $\frac{1}{16}$ in. there will be no difficulty when grinding work as thin as 0.005 x $\frac{1}{2}$ x 2$\frac{1}{2}$ in., using a wheel equivalent to grade G, grain 46, Norton list. The small wheel should run at the speed recommended for the 7-in. wheel; this low peripheral speed reduces the friction and causes the wheel to act similarly to a softer bonded wheel. As light cuts must be taken on thin work, this effect, similar to softening of the bond and due to the slow speed, does not result in greater loss of size.

If rotary laps are used in place of abrasive wheels and the magnetic chuck is used to hold the work do not use a magnetic metal for the body of the lap.

Surface Laps

Surface laps should be made of soft, close-grained cast iron, free from sand and blow holes. The casting should be thoroughly annealed. The object of this annealing is not so much to remove the stresses as to insure that the iron in the lap is softer than ordinary cast iron used for temporary lapping fixtures, similar to *F*, Fig. 99, used to hold and control the work. It is very desirable to release all casting stresses by annealing, and then by seasoning with age, after planing; but as the action of the abrasive sets up stresses that are retained by the lap they partly nullify the effects of annealing. The lap has to be of the softest iron to obviate the excessive wear which will occur if the fixtures are of a softer iron than the lap. Because of this wear the removal of the casting stresses is not important.

In order to resist lapping stresses a bench lap should be a solid casting. In Fig. 95 is shown a diagram of a lap that stands up well. It is flat on the lapping surface and beveled at the edges. This bevel is about 0.005 in. deep. It frequently occurs when using the surface at the edges of the lap to equalize the wear on the surface of the lap that the work will be so far over the edge it will snap off the lap.

Truing Surface Laps

Surfaces that the average planing machine produces are not planes. If there is no accurate surface plate to test the newly planed surface of the lap there should be three laps used as they will have to be compared one with the others in the same manner that surface plates are originated. The surfaces of the laps should be as near planes as possible. To make them so, one must reduce the hills and valleys that are allowable in a surface plate by lapping the laps together. These valleys in a lap have the same effect as checking which is sometimes used on lap surfaces.

The surfaces of the three laps, having been tested with a surface plate or by scraping one with the other until they are about 90 per cent. plane, will have to be reduced to true planes by being lapped together.

If the surfaces produced by planing are fairly accurate, scraping will not be necessary, and perfecting of the surfaces can be done in the following manner. This will prove the surface of the lap a plane and at the same time originate a proved straightedge.

Three surfaces are required to prove a straight line. As it is impracticable to match two knife-edge straightedges together, a combination of a knife-edge *B* and a flat surface *A*, as illustrated in Fig. 96 in the wooden holder *C*, is used, the surface of the lap being the third surface required. The dimensions of *A* and *B* are the same and are of sufficient strength to resist the distortion (curling) caused by lapping. The $\frac{1}{16}$-in. flat surface on *A* gives sufficient surface to test the knife-edge *B*. The knife-edge *B* is guided by the wire steadyrests that are set in the wooden holder *C*. The small block is a wooden button used to hold *A* with a light pressure of the thumb of one hand when testing or comparing the edges.

If the surfaces are not very accurate, grain 120 carborundum is used, when lapping the cast-iron laps together. This grain should be used even when fairly accurate surfaces are produced by the planing machine, as the crushing of this coarse abrasive induces stresses that will not be equalled when the finer grades are used for the correction of the lap surface, either at the finish correcting of the planing-machine errors or when correcting the wear on the lap surface from use, and resulting in more permanent laps.

A Concave Lap Will Lap a Plain Surface

It is not generally known that a concave lap will lap a plane surface if given a sweeping, not rotary, motion. The surface around the central depression must, however, be kept in contact with the surface to be trued. This depression *E*, Fig. 95, should be about one-third of the surface of the lead lap *F* used to finish and retrue cast-iron laps. The lead for this lap is poured in the cast-iron holder *G* that has been drilled for the body size of a number of irregularly placed $\frac{1}{4}$-in. screws *H*. The lead shrinks in cooling, and the object of these screws is to hold the lead casting firmly to the cast-iron holder. The screws used when casting the lap should be about $\frac{1}{4}$-in. longer than the screws used to draw the cast lead to a seat. They should also be doped with graphite to keep the lead from adhering to them. The longer screws are taken out and shorter ones used to replace them, the extra length of the first screws used giving plenty of recess to allow clearance for the ends of the short screws as they are tightened.

It is practically impossible to anneal several castings to an equal degree of softness, as there will always be one lap that is softer than the others. This soft lap will not be reduced to a plane by lapping its surface with the others, and it should be discovered before it laps the surface of the other two laps convex. A rough test to discover the soft lap is to rotate, or spin, the different laps together alternately. After they have been lapped enough to make a surface, they are washed with gasoline, and a little Prussian blue is applied to the surface of one lap; the others are then rotated on this blued lap. The surface that shows the narrowest line of contact will have the most pronounced depression and probably will remain concave until the other surfaces prove up ready for the final finishing with the lead lap; this stage of the surface is revealed with the steel straightedge.

After grinding the pieces *A* and *B*, Fig. 96, the narrow edge of the piece *A* is lapped, using the fixture *D* to hold the edge horizontally. The fixture *D* and the piece *A* are held together with a light downward pressure, with the fingers on the piece *A*. The fixture and piece *A* are given a sweeping motion over the entire surface of the lap. The knife-edge *B* is then lapped with a rolling motion to produce a rounded edge and using the same surface of the lap. The edges of *A* and *B* are now the opposite of the surface of one lap. If they are straight they will shut out light when they are placed together, as shown at *G*. As these two edges are the opposite of the third surface—that of the lap—and their edges fit each other, this proves them to be straightedges.

To Detect Local Errors

If an error shows on the pieces *A* and *B* it will be equal to twice the error of the lap surface, and will be caused by local high spots on the lap or by a concave or convex lap surface. The line diagrams *H*, *H'* and *I*, *I'* in Fig. 97 will make the error caused by a concave or convex lap plainer than a written explanation. To detect the local error the edges *A* and *B* are lapped, using a straight-line movement, as indicated by the arrows on the diagram *K*, using the surface of the lap as indicated by the dotted lines. Local errors seldom occur when finishing the iron laps with a lead lap, as the lead lap reduces the soft, high spots in the surface of the cast-iron lap more accurately than does a cast-iron lap. Local errors should, however, be discovered, as they can be reduced faster when their location is known. To reduce them, smaller plates of cast iron are used to lap with. As an example, let us say that the corners of the lap are supposed to be high, as the lap has been used a good deal. The steel straightedges are lapped with an overhang, as illustrated at *L*. Then the edges are relapped just enough to make the ends of the edges match, as shown at *M*, care having been taken not to lap the error out. If there are errors at the corners of the lap they are corrected with a small cast-iron plate, using 5-min. carborundum; this grade is also used with the lead lap.

It is not necessary to generate a proved straightedge if an accurate glass test bar is at hand. There should always be one handy, as the retesting of a lap is simplified by making a 7-in. straightedge on any part of the lap's surface and checking its accuracy with the glass test bar as a standard. The single error that cannot be discovered when a glass test bar is used will not harm the average gage.

Gages for production work do not require an extremely smooth surface. This permits a very hard brittle abrasive to be used in preference to a softer tough abrasive. The brittle abrasive renews its sharp edges when it crumbles. These sharp edges require less pressure to make them cut the work. This is a desirable feature with thin work. They also retain their hold upon the surface of the lap more firmly than a dull tough abrasive. Rolling grains are very destructive to the surface of the lap. It takes more pressure to dislodge a tough abrasive and make it roll than it does to crush a brittle abrasive grain. The parts of a brittle grain that has been crushed are of course smaller than the original grain. They are more apt to lodge in the spaces between the large grains and be retained there than is a tough grain that is merely worn smooth or dull and rolls over.

When two laps are finished by rubbing them together with abrasive between them to produce a plane surface, their surfaces become charged with abrasive that is more firmly embedded than that applied at any subsequent recharging, as the weight of the upper lap and the pressure applied will be more than is necessary to recharge a dull lap. Although a coarser-grained abrasive is used to finish the lap surfaces than when lapping gages the coarse grains of the abrasive are brittle and are readily crushed. The plain iron surface of the lap receives these sharp crushed grains very freely. An old charged surface has to release the old grain before it can accommodate the new one. There are certain results obtained when finishing hardened-steel surfaces that lead one to know that only the finer particles of the coarse-grained abrasive are retained in the surface of the cast-iron lap after a freshly charged lead lap has been used to strip the coarse abrasive from it. After using the lead lap to strip the abrasive from the cast-iron lap the cast-iron lap is washed with gasoline, using a piece of duck cloth for a wiper. If a film of kerosene is now applied to the surface of this coarse-grained charged surface it will produce a finer finished surface than where the original uncrushed grain is used to charge the iron lap. The lap is now washed clean. The last-size grain used was 5-min. carborundum; the 15-min. grade used for finishing gages will produce a surface far superior to what the 5-min. produced. By using the same surface of the lap, as previously, one will be convinced that when a lap is recharged, as described, the 15-min. abrasive is not embedded into the surface of the cast iron but lodges between the fine particles of the original coarse abrasive already embedded therein.

Recharging a Lap

The pressure required to recharge a lap need not be heavy. The object is to attach the abrasive firmly enough to the surface to resist the tendency of the work to displace it. The requisites for recharging a lap are a can of kerosene, one of gasoline and a hardened-steel block about ¾ x 3 x 3½ in. This hardened-steel block will not become charged and retain the abrasive as the old cast-iron block does (thus destroying the accurate surface of the lap), but it spreads the abrasive evenly over the lap surface. It will be readily seen that the abrasive cannot be sprinkled evenly from a container.

Two or three squirts of kerosene are shot onto the surface of the lap. Then the abrasive is sprinkled on and enough gasoline added to make a mixture that is thin enough to be easily spread around, using the hardened-steel block and pressure enough to imbed the new abrasive grains into the surface of the lap between the old imbedded abrasive grains. The lap surface is then wiped with a piece of duck cloth to remove the surplus abrasive and moisture. The resultant surface obtained by this way of charging will approximate very closely to that of a piece of abrasive cloth, besides having the added advantage of being self-sharpening as long as the film of kerosene lasts. The film of kerosene left after the gasoline has evaporated should be as thick as possible, up to the point where the edges

of the work will not become rounded (in a hole this rounding would be called bell mouthed) from ploughing through the mixture of kerosene and abrasive. The proper mixture of kerosene, abrasive and gasoline will be apparent after a little experience.

It may be useless to say that if peening is not required the piece will not be peened. But to show the fallacy of the old idea that peening should not be done in the operation of making gages we will show what takes place in a piece of hardened steel that has been influenced by lapping.

When grinding the gage it was necessary to peen it to keep the distortion within certain limits. It will be found that peening will have to be done to keep the gage flat while lapping it and is used to produce the same effect as when grinding; that is, to balance opposed stresses. In fact it is becoming the common belief that lapping is a refined process of peening. It has the same effects as a peen hammer, but leaves a better finished surface. If lapping produces the same effect as peening there is no reason, other things being equal, why peening should not be employed.

To those who have not had the chance to see the effects of the lap this will be a surprise, and possibly they will think it is their ignorance of the art that causes the trouble. They can be assured that all gage-makers have the same troubles, but have become used to them, as they are unavoidable. Knowing the effects of lapping, as small an amount as possible is left to be lapped off the work. This amount need not be over 0.00015 in. if the grinding machine is in a good condition and a free cutting wheel is used.

Changes That Will Occur

Taking the piece *A*, Fig. 98, as an example we will note the changes that will occur and the means taken to counteract them. The last surface ground generally remains concave, but equidistant, from the opposite surface. It is evident if the piece *A* is lapped on the concave surface *G* (the last surface ground) that the ends will be thin. But it is not evident to those without the experience that if the piece *A* is lapped enough it will assume the shape of the piece *B*, or concave upon the opposite surface, and if there is a continuation of the lapping the ends will curl away from the lap as shown at the ends of the piece *C*.

Before lapping, the curl caused by grinding is counteracted by peening with the hammer upon the concave surface *G* of the piece *A*, Fig. 98, enough to make the top surface *F* flat when tested with a knife-edge straightedge. This peened surface *G* is then lapped lightly, testing the surface *F* frequently with the straightedge. When the ends of surface *G* begin to curl away from the lap, and this action takes place very quickly, the surface *F* is peened enough to straighten the surface *G*. After the surface *G* is grayed, or rough lapped, it will be noticed that the opposite surface to the one being lapped will always have to be the one peened with a hammer to counteract the peening or compressing of the surface of the work caused by the abrasive of the lap being forced below the surface before it starts to cut. In fact these grains of abrasive become thousands of minute peening hammers so far as effect is concerned.

Before the grinding marks are wholly erased by lapping on the surface *G* the lapping of the surface *F* is started. Now the surface *G* starts to curl concave and has to be corrected by peening the surface *G*. The surface *G*, having been partly finished, will show a smaller error out of plane when tested with a straightedge than one that is tested as the wheel leaves it, because the finished surface is more even. A very close approximation to a plane can now be obtained by peening with a hammer to correct the errors that are disclosed with a knife-edge straightedge.

Reducing the High Center

When lapping alternately on each surface another condition now enters that will be discovered with a micrometer—the edges are approaching dangerously near to the desired finished size and the center is thick, as illustrated at *D*. One of the best ways to overcome this is to continue lapping upon the surface that curls away from the lap, keeping close tabs with the micrometer to see that the center does not become low. As the curl will become extremely pronounced during this lapping it must be reduced by peening with the hammer. The curl is not entirely removed, the reduction of the curl being just enough to allow the bellied part at the center of the gage to be reduced by lapping. Reducing the high center should not be done all on one side of the gage. About one-half of the amount of the high center should be lapped off one surface. Then this surface is made a plane by peening the opposite surface, and then the opposite surface is lapped, maintaining the plane that was corrected by peening. This keeps the edges from being lapped away and allows the lap to reduce the high center. When finishing the last surface the micrometer should be used frequently to test the parallelism of the surfaces and their distance from each other as the knife-edge straightedge merely tests the surfaces for flatness.

The foregoing may seem a little involved, but if a piece of hardened and ground steel is taken and the processes carried out as described the reasoning will be very apparent.

The curling effect is induced whenever the surfaces are disturbed, but will only show when the effect is strong enough to overcome the resistance of the metal in the piece being worked. The angular piece *A*, in Fig. 99, gives an illustration of the powerful distorting effect that lapping will induce. The piece *A* is ground ready to lap, when the surfaces *B*, *C* and *D* are lapped; a change of the angle will be discovered with a knife-edge angle tester. This change is due entirely to the effect of lapping and not to uneven application of pressure. The control of this distortion upon angular shapes becomes a difficult proposition. The hammer and oil-stone help to a limited extent, but the principal correction will have to come from the lap. This is done by simply keeping the surface *B* flat. The surfaces *C* and *D* are lapped alternately and tested for the angle from the surface *B* before correcting the distortion on the surface *B*. This test will show whether the hammer can be used a little, as the surface *B* does not curl equally, so it is desirable to keep the angles equal for measuring purposes.

The use of the peen hammer on angular surfaces is limited. As there is no support to resist the blow, which is liable to start a fracture, it should therefore

be used with caution. The India stone is preferable if the induced stresses can be made strong enough. In my estimation the scratches caused by the stone are a benefit, because they will hold the lubricant that will prevent the seizing or set of two surfaces that are a good fit. Lubrication also stops the guesswork when trying gages for parallelism. The loss of wearing surface caused by the scratches is negligible.

Too Much Pressure

When lapping the angular sides *C* and *D* there is danger that too much pressure is exerted from the one edge to an edge of the surface in contact with the lap, as shown by the arrow in diagram *E*, Fig. 99. A lapping block or guide, as shown at *F*, will overcome this, as no direct downward pressure is exerted by the fingers holding the work. The use of two hands will give less wear on the lapping block, one hand to hold the lapping block and the fingers of the other hand to press the work at *C* against the block and at the same time downward toward the lap. The angle on the lapping block governs the position the work will take when it is pressed downward at approximately the same angle. The undercut at *G* is made for the curling of the edge, and the height of this undercut will be governed by the angle being lapped.

All the surfaces of the block *F* except the angle should be square with the top and bottom surfaces. These are reference surfaces that can be tested with a knife-edge square to discover the error caused by uneven pressure upon the lapping block or guide when in use upon the surface of the bench lap. The correction of this error is made by regrinding the surface used upon the lap, using the surface *H* to bed upon the chuck. These holders should be made of cast iron that is harder than the lap.

Illustrated in Fig. 100 are several fixtures to control work while being lapped. The fixture *A* is a double angle iron; the sides are square with the top and bottom. The body of the fixture is made of cast iron, with hardened-steel inserts *C* at the bottom. These are secured with hardened screws, not shown, that have their slots removed after being set home, the counterboring for the heads being shallow enough to expose the bottom of the slots. This removal of the slots makes a smooth surface that will not become loaded with abrasive when used upon the lap.

When through use the fixture is worn out of square, it is reground upon the steel inserts, using the top surfaces *D* to bed upon the chuck. The piece *B* upon the side of *A* is used to control the work when lapping the ends of pieces that are out of square with their sides. The hole in the center is for the stud that holds the piece *E*, which swings upon this stud, giving the rounding edge that is required upon knife-edge squares. The square is held against the angle iron, also upon the piece *E*, rotating the piece *E* the desired amount; at the same time the angle iron is swept around the surface of the lap.

When lapping the ends of work of great height it is often difficult to hold the work steadily. A piece of insulating tape wrapped around the work low down, as shown in Fig. 100 at *F*, will give control of such a piece when it is being lapped. Rubber finger tips will also give a firm hold in place of the tape. The tape will also give a purchase so that pressure can be exerted upon the side needed to correct the end if it is out of square. At *G* the tape is placed on the bottom of a block to hold thin work. When used for this, care should be taken to see that the center of the work does not get lapped below size, because when the edges of the work curl they will sink slightly into the tape, while at the same time the center of the work is better supported, there being more surface in contact with the tape. When work to be lapped is on the tape there should be a measurement taken over all. This will show the parallelism of the work and block combined and save several removals of the work for measurements as the lapping proceeds. For a piece wider than the tape, the tape is placed upon the surface of the holder in strips. On very thin and wide surfaces the tape on the block will hold the work more accurately than the fingers if a light pressure is used when lapping. Rubber finger tips are a handy thing to have when lapping some kinds of work that or so thin that they will not stand without distortion the pressure required to move the work with the bare fingers over the lap.

Originating a 90-Deg. Angle

To originate a 90-deg. angle requires the use of three accessories; that is, two angle plates and an adjustable knife-edge square. The adjustment of the blade is necessary, as the first trials for 90 deg. will probably not be accurate. The angle plate *A* in Fig. 101 is one of a pair that will test any square. The knife-edge square, the third accessory required, is shown at *B*; it is adjusted by the screws in the end and its construction is very simple.

The angle plates having been roughed out will, if there is an error, double it when tested, as shown at

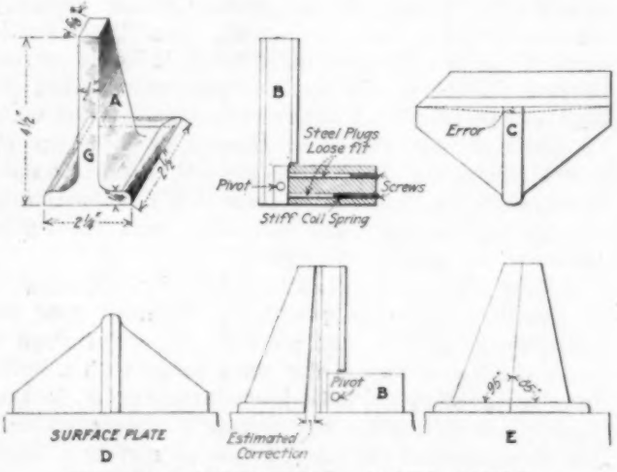


FIG. 101. ORIGINATING A 90-DEG. ANGLE

C. With the accurate commercial try-squares that are obtainable today this error will probably be small enough to be corrected by lapping, although it will be easier to obtain a good finish on the surface if they are ground before lapping. After placing them upon the surface plate, as shown at *D*, and clamping them lightly together they should be tested with the straightedge, as shown at *C*. The amount of the error is estimated and the square *B* adjusted to as near one-half of the error as possible. The long, narrow surfaces *G* of the

angle plates are the ones on which the correcting is done. These two surfaces of the angle plates are lapped to fit the knife-edge square and then tested again. The testing and lapping should be carried on till the surfaces will shut out the light when tested with the knife-edge straightedges, as shown at *C*. This will give a 90-deg. angle that is proved correct to twice the length of the beam of the square used.

There will be a temptation to place the angle irons together, as shown at *E*, and lap them in that position. The diagram *E* shows the possible result of using this method. The sum of the two angles would be two right angles, but neither of the angles would be a 90-deg. angle.

These angle plates are as easy to make as a hardened, ground and lapped cylinder which is sometimes advocated as a standard to test squares. The cylinder will test a beam square all right, as there is a broad surface to the blade. But when it comes to testing a knife-edge square there will come a time when the edge will have to be tested to see if it is straight. This will have to be done on a flat surface and is one of the proofs that a cylinder is not the best standard that can be used to originate a 90-deg. angle.

This article brings the reader to where he will begin to understand the reasoning to be employed when planning the ways and means to make gages. This refers to that habit of thought alluded to in the first article. It will require little effort, but as he sudies the drawing of the gage he will at once see where distortion will be caused by grinding and lapping and what temporary fixtures will be required to make the gages.

Use of the Drilling Machine for Intricate Boring Operations

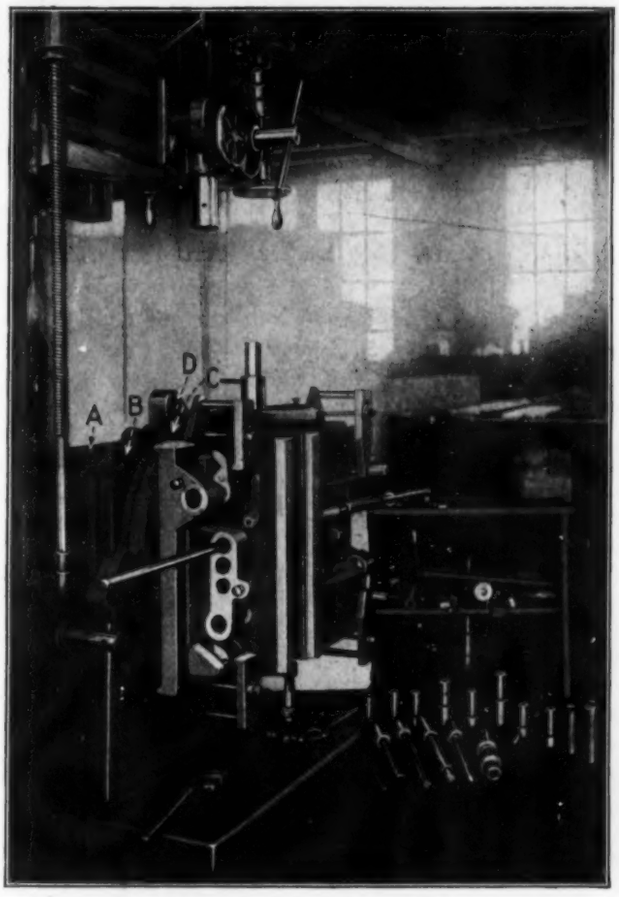
One may frequently go into shops and find instances where work is delayed owing to what the management asserts is inadequate boring-machine facilities. A study of such conditions will often point to the fact that work is being crowded onto the boring or milling machine, which can more profitably be handled on large radial drills, provided the proper jigs are designed and built.

Such jigs should never be considered as an additional expense when made for such a purpose, for while different kinds of work can be handled on a horizontal boring machine without using a jig, the time occupied in the set-up and machining will be far longer and the work much less accurate than would be the case were the proper tools furnished for this purpose.

A case in point which shows what remarkable efficiency can be obtained from a radial drilling machine when used for such purposes in the boring of machine parts is shown in the illustration. This is a special drilling fixture which was built by the Oakley Machine Tool Co. of Cincinnati and used by it in machining the saddles of its universal grinding machines. This drilling jig was fitted for use on a Morris radial drilling machine and was so arranged that all sides of the casting could be drilled and bored in one set-up.

In order to accomplish the desired results a large angle plate *A* was first constructed, upon which was mounted the base of the jig *B*. This base has a central pivot upon which the part *C* of the jig, which carries all the drill bushings, etc., may be revolved in order to turn the different sides uppermost in succession in order that the drilling operations may be properly performed. The revolving feature of this jig is a very valuable one, and as it is turned into the different positions, holes are provided for stop pins, such as the one shown in the lug *D*, which insure that the jig will be accurately in position before the operations are started on any face.

This same swivel plate *B* has been designed as a standard and so arranged that it can be used in connection with several other swivel jigs of similar style.



A REVOLVING DRILLING AND BORING JIG

Some of the boring bars and reamers used in connection with this particular job shown in the drilling machine may be seen lying on the floor and on the bench at the right. They give a good idea of the great variety of operations that can be successfully employed even in the manufacture of one piece of machinery such as that shown. It should be remembered that all the work so accomplished is remarkably accurate as would be required in the best of machine tools.

Shellac for Pasting Card Indexes

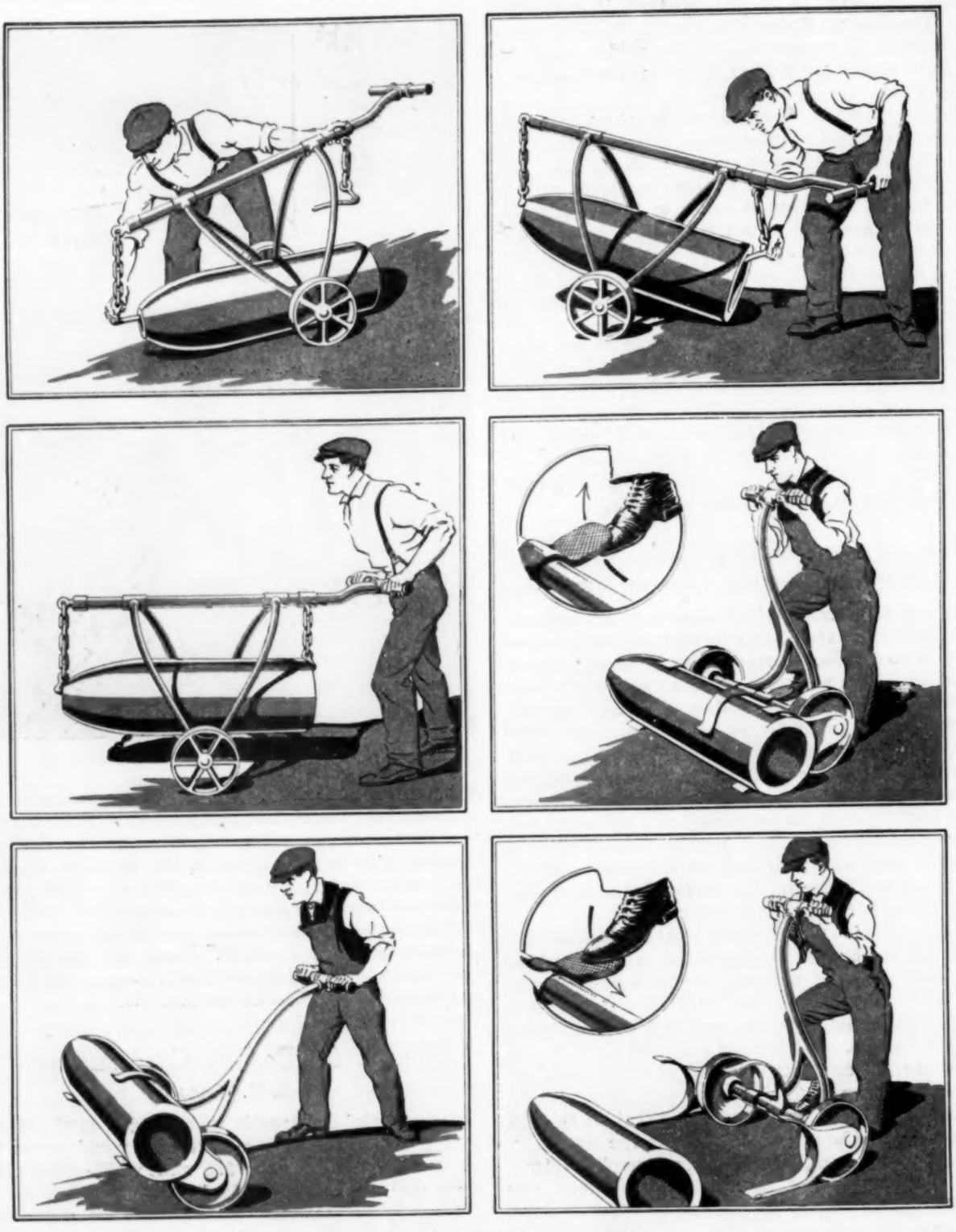
By A. H. Halladay

Anyone who has trouble in making a good job of pasting, especially for card indexes, I would advise to try shellac. The cards stay flat, while with the ordinary paste they curl up like a fried fish.

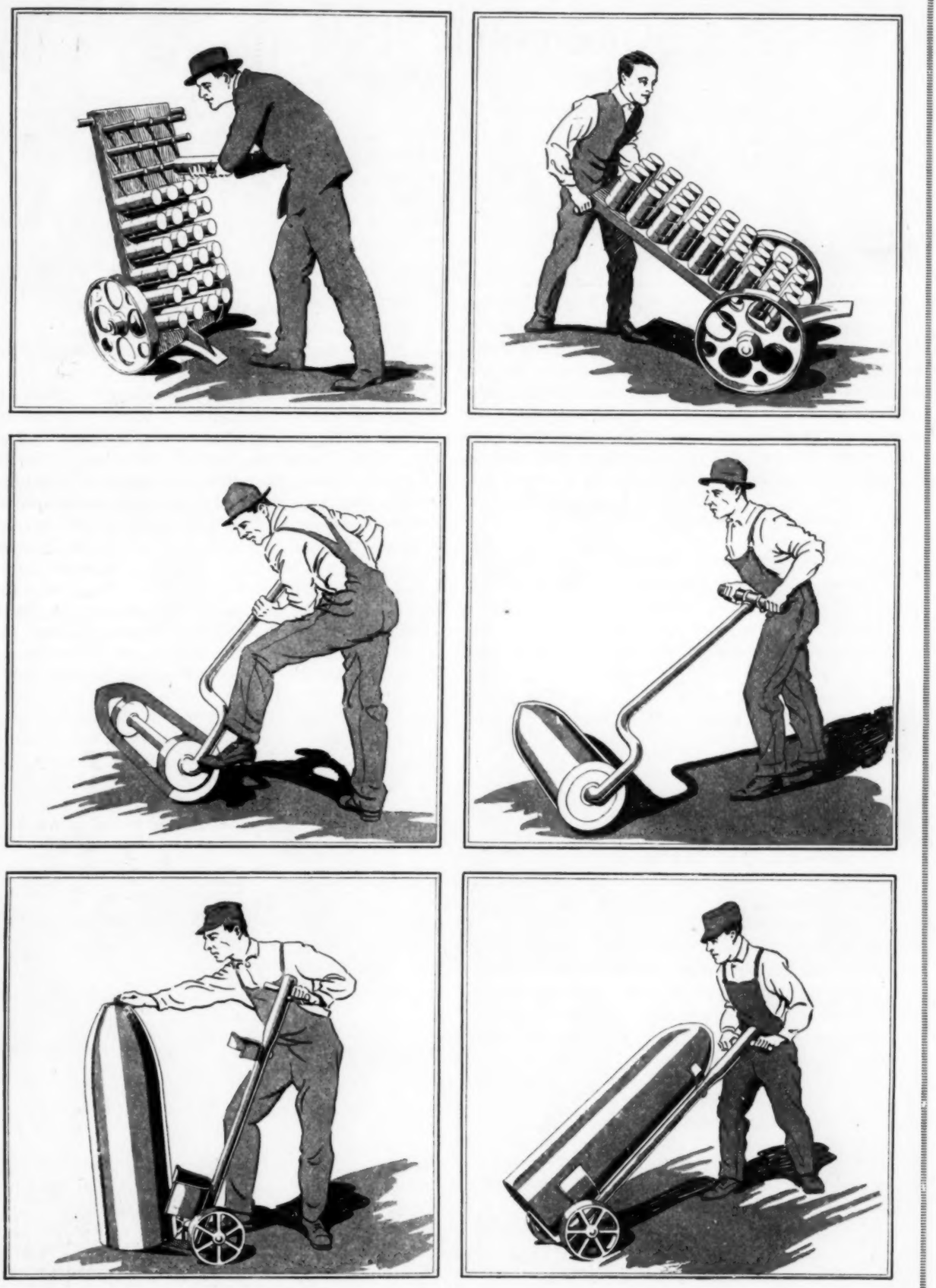
I use a can like the one described on page 990, Vol. 46, of the *American Machinist*. Keep the shellac thick and it will take hold right away.

From a Small-Shop Notebook

By J. A. Lucas



VARIOUS SHELL-HANDLING DEVICES



VARIOUS SHELL-HANDLING DEVICES

The Manufacture of the Sperry-Type Automobile Radiator

SPECIAL CORRESPONDENCE

While there are always certain similarities between the manufacture of the same product in different localities still the methods used in the making of this type of radiator may be of interest to others engaged in the manufacture of sheet-metal goods.

A NEW type of automobile radiator known as the Sperry type, which has some interesting features, is now being manufactured by the Hoover Radiator Co., of Chicago. It is not the intention of this article to go into details of construction of this radiator beyond the explanations necessary to understand the methods of its manufacture. By referring to the sectional view shown at *A*, Fig. 1, it will be seen that the two parts *B* are shaped so as to form the portion *C*

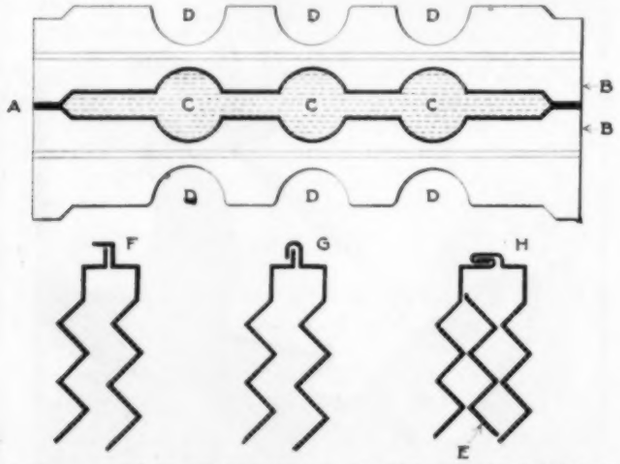


FIG. 1. DETAIL SECTIONS OF PARTS OF SPERRY-TYPE RADIATOR CORE

through which the water circulates. The spaces *D* when the parts are joined make a wide opening for the flow of the water corresponding to a tube in the tubular types of radiators for insuring nonstoppage of circulation, while the thin layer of water at each side provides the greatest possible radiating surface.

A further idea of the construction may be gained from the view of some of its parts shown in Fig. 2. The portion at *A* shows some of the loose sections. At *B* is one of these sections stood on edge showing the grooves that, after assembling, form the tubular passages. The edge view of a section of a radiator core after assembling and soldering is shown at *C*. The piece *D* in the lower section is a spacer sheet which makes up into the general form of the radiator to join its sections together and space them. This corresponds with part *E* in Fig. 1.

The sheet brass of which the radiator core is made comes in rolls, the metal varying in width with the thickness, and consequently the cooling capacity, that the radiator is to have.

The first operation is to feed this brass strip through a set of corrugating rolls, thus making the corrugations without stretching the metal as would occur should this operation be performed with dies.

One of the rolls for this purpose is shown in Fig. 3 with a corrugated strip of brass extending to the left. The gears at the right and left of the roll housings have been carefully guarded, but the rolls themselves are unprotected. This is a wonderfully compact little machine and does its work very successfully.

These machines, as is all of the equipment of the plant, were designed by the superintendent, Charles F. Sperry, and built in the shop.

The corrugated strips are taken to punch presses similar to the one shown in Fig. 4, where they are given their final form by means of the dies shown in position. This die performs several operations at one time, including cutting the strip to length and forming the interlocking ends, this forming being accomplished at the center of the die as shown at *A*.

In starting this operation the stock is fed into the die from the right until this central portion of the tools can form one end and trim it. The strip is then fed to the left and spaced by the corrugated stop *B*. The next stroke of the punch forms the opposite end, and at the same time forms one end of the next following piece. The shape of the ends so formed are shown in Fig. 1 at *F*. The parts *C*, Fig. 4, are guards to protect the operators' hands.

Some idea of the construction of these dies can be gained from an examination of Fig. 5. The lower die *A* is made up in longitudinal sections, in which slots are milled to receive pieces of drill rod *B*, to form the tubular impressions. The slot is milled to one-half of the total diameter of the drill rod in each side of these

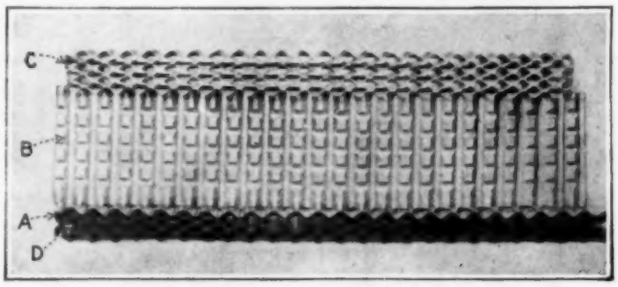


FIG. 2. RESULTS OF PRESS WORK ON THE BRASS CORE SECTIONS

sections, and to a true radius. The dies are then assembled without putting in the rods and the corrugations are milled across their faces, after which the rods are put in place. The ends of these rods show plainly in this view, also the adjustable stop *C*. The guard *D* has been swung to one side, enabling the operator to get at the parts easily when setting up the die. The working parts of the dies are made of tool steel and are held in blocks of cast iron.

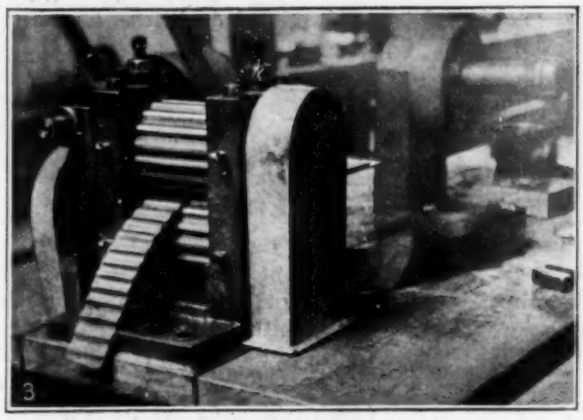


FIG. 3. THE FIRST OPERATION IS CORRUGATING THE BRASS STRIPS

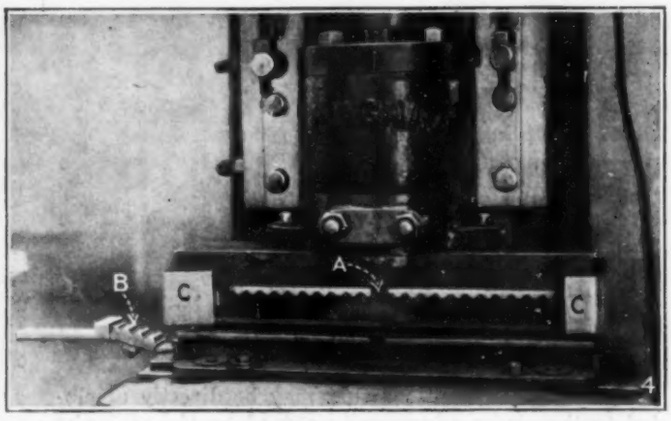


FIG. 4. PRESS TOOLS FOR FORMING OPERATIONS ON CORE SECTIONS

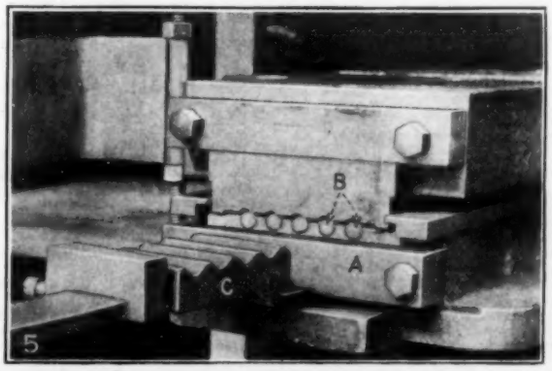
The spacer section shown at *E*, Fig. 1, contains no tubular grooves, and is pressed into accurate form, after first going through the rolls, by the dies shown in Fig. 6.

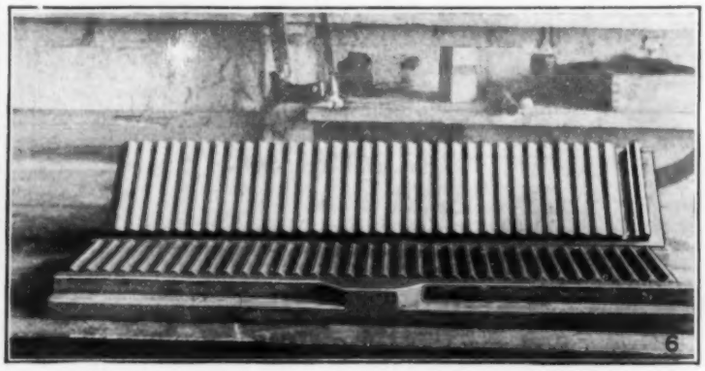
After the sections are finally shaped by the dies they are assembled in the form shown at *F*, Fig. 1. An operator then places them over the mandrel of a special machine, trips the clutch with a foot lever, and two side pieces come together clamping the two sheets firmly to the mandrel. Two rollers then pass over this joint, the first of these pressing the joint together in the form shown at *G* and the second, rolling it down flat and tight against the mandrel as indicated at *H*. The machine then automatically releases the pieces with the seam firmly interlocked.

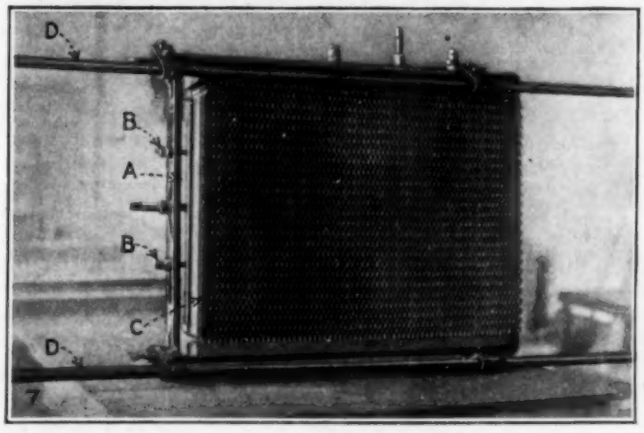
The parts of the radiator core are assembled on a table and when the correct number of pieces are arranged, a special clamp is fitted around them to draw them together as shown in Fig. 7, where the side bars *A* contain setscrews *B* by which the sides *C* can be pressed in until the correct size of core is obtained. The handles *D* of light pipe are then quickly slipped on by slotted straps and serve to handle the core during the soldering process.

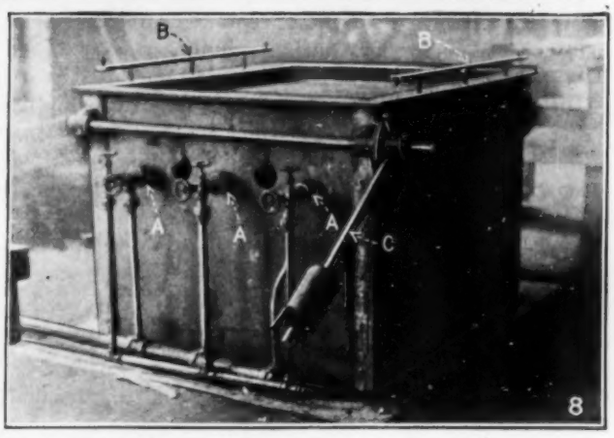
For this operation the core is immersed in a liquid soldering flux contained in a shallow tank. The depth of the liquid is just sufficient to cover the core to the neecssary depth for soldering.

The soldering operation itself is done in the tank shown in Fig. 8, which is a shallow cast-iron pot heated with gas burners *A*. The pipe handles carrying the core in its frame are laid across the adjustable bars *B*,









FIGS. 5 TO 8. FORMING AND SOLDERING OPERATIONS

Fig. 5—Details of die construction. Fig. 6—Die for pressing spacing strips. Figs. 7—Radiator core assembled in soldering frame. Fig. 8—Gas-fired soldering tank for radiator work

which are connected with and operated by the counterweighted lever *C*. By this means the radiator core is lowered into the solder bath to the desired depth to which the solder joint should extend.

After soldering both sides of the core it is removed from its frame, and the same bath is used to solder the edges and insure a tight joint at the point where they interlock. The core is then ready for assembling in the upper and lower tank sections.

Ulco Hard Metal a Substitute for Babbitt

Of the many inventions that may be directly attributed to the stress of necessity caused by the war, the discovery of a new alloy which appears to be performing the office of a number of other metals is of the greatest importance to industrial America and incidentally of vital assistance to the Government in its efforts to conserve the rapidly diminishing tin supply of the world.

In the summer of 1915, when the foreign demand for shrapnel balls was at its height, causing famine conditions in the antimony supply, antimony was selling at 45c. a pound in New York. Even at this high price there was no antimony to be had. Conditions had become so serious that the United Lead Co., one of the large American manufacturing companies, issued orders to its technical force to find a substitute for antimony. It was not long before this condition was brought to the attention of Professors Frary and Temple, then of the University of Minnesota, who spent their vacation in developing a metal that could be used for shrapnel balls, Their results were successful in the fall of the year, when their product was offered to the manufacturing company originating the suggestion and steps were at once taken to manufacture the metal experimentally at Keokuk, Iowa.

The metal has been designated "Ulco Hard Metal." It is hard and tough and has a distinctly metallic ring, despite the fact that in chemical composition it is 98 to 99 per cent. lead, plus barium and calcium. These elements are introduced by an electrolytic process, and hence the plant for the production of the metal was erected at Keokuk, where the electrical energy developed by the Mississippi River at the Keokuk Dam was available.

Shrapnel balls manufactured from the new alloy were pronounced superior to the lead and antimony ball by reason of their higher specific gravity, greater toughness and the complete absence of brittleness—all these qualities combining to produce a ball with superior ballistic effects. Yet about the time the metal was fully developed for this purpose antimony had receded in price to such an extent as to make the use of the new metal for the special purpose unnecessary.

The research laboratories of the manufacturing company responsible for the introduction of the metal devoted themselves diligently to the study of its peculiar nature, and have since discovered its real worth in bearing metals. Here the metal is found to possess hardness, compressive strength, low friction and heat resistance—all the qualities of a high-grade babbitt.

Tin lends an element of hardness and toughness to babbitt; antimony hardness alone; and it has been generally supposed that where lead was used in a babbitt it added greatly to its antifrictional qualities. The new metal having all these characteristics, being principally lead, with its high antifrictional qualities, appears to be supplanting babbitt of the higher grades. Moreover, of special importance is the fact that the new metal is conserving the supply of tin so urgently demanded by all the nations at war.

Ulco hard metal may be cast, rolled, drawn and extruded; its melting point is the same as lead, and its specific gravity about the same. The metal has been undergoing a test conducted by the United States Bureau of Standards, and we are permitted to report the results of the test as follows:

A 10-lb. ingot of Ulco hard metal, the original Brinell hardness numeral of which was 25.2 at a load of 500 kg., was melted down, and chilled castings were poured at various temperatures with the following results:

Temp. °F.	Temp. °C.	Brinnell Hardness Numeral
650	343	23.5
700	371	25.1
750	399	25.0
800	427	25.7
900	482	22.8
1,000	538	22.0

The metal was fluid at 650 deg. F., and though the maximum hardness was produced by pouring at a temperature of about 800 deg. F. the hardness was not greatly reduced by pouring higher temperatures.

Test bearings were then poured and service tests made in an Olsen testing machine, tests on genuine babbitt being made at the same time to serve as a basis for comparison. The table below gives the results of these service tests:

GENUINE BABBITT

Load Lb. per Sq.In.	R.P.M.	Total No. of Revolutions	Final, °C.	Final, °F.	Temp., °C.	Rise in Temp., °F.	Friction, Lb.	Loss in Weight, Gram
100	694	12,230	89	192	53	95	22	0.023
200	706	16,510	102	216	58	104	29	0.021
300	682	15,150	125	257	100	180	38	0.013 (*a*)
400	603	6,600	139	282	94	169	79	0.054 (*b*)

(*a*) Belt slipping. (*b*) Bearing seized and smoking.

ULCO HARD METAL

100	710	13,160	56	133	23	41	13	0.013
200	715	18,870	69	156	33	59	18	0.021
300	719	18,830	80	176	42	76	27	0.013
400	711	17,310	81	178	43	77	23	0.022
500	723	17,660	79	174	43	77	25	0.014
600	692	14,960	84	183	45	81	24	0.021
700	648	24,520	62	144	38	68	24	0.020
800	365	12,870	53	127	20	36	23	0.010
900	408	22,300	59	138	22	40	24	0.015
1,000	405	23,200	66	151	36	65	22	0.014 (*a*)

(*a*) Bearing still in good condition.

The Ulco hard-metal bearing was still running excellently at 1000 lb. per square inch load, but as the capacity of the testing machine was reached the bearing could not run to failure as in the case of the genuine babbitt bearing.

It will be noticed that the Ulco hard metal ran considerably cooler than the genuine babbitt, the friction was less and the wear also a smaller amount. It should be borne in mind that the specific gravity of Ulco hard metal is much greater than that of genuine babbitt, and for equal loss in weight the volume loss would be less in the case of Ulco hard metal.

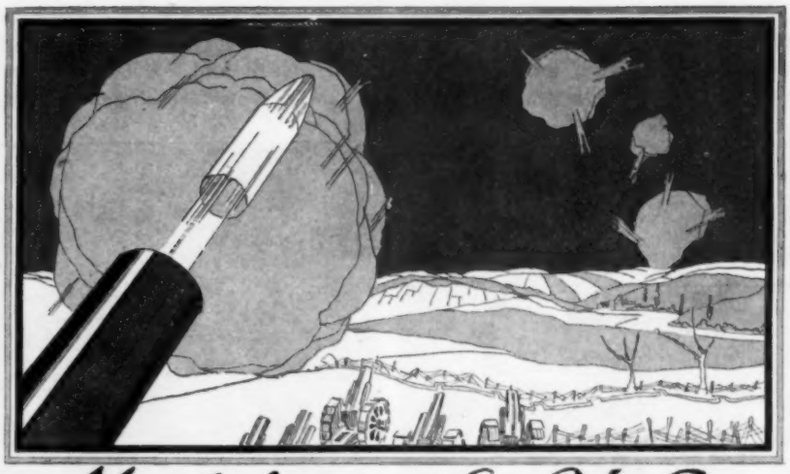
These tests were repeated on new samples with substantially the same results as above. A test was also made in which no lubricant of any kind was used in the bearing. The bearing was run at a speed of 700 r.p.m. and 50 lbs. per square inch pressure, and after about 10 min. the metal began to flow and adhere to the steel shaft, scraping out more of the metal from the bearing. The shaft was not injured in the least by this test, and the metal that had adhered to it could be readily removed with a knife.

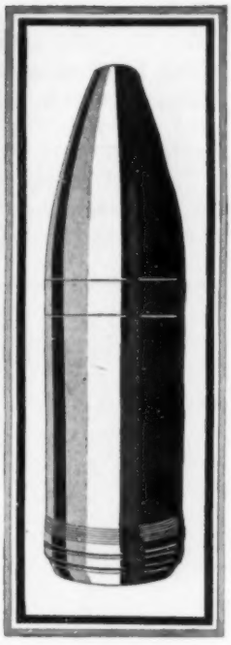
Tensile tests on Ulco hard metal and genuine babbitt cast under similar conditions gave the following results:

	Tensile Strength Lb. Sq.In.	Elongation % in 1 Inch	Reduction of Area %
Genuine babbitt	10,600	15	8
Ulco hard metal	13,000	5	1

The fracture of the babbitt showed blowholes, reducing the section approximately one-fourth, though the Ulco specimens were sound throughout. The average elastic limit in compression of Ulco hard metal was found to be 11,525 lb. per square inch.

Further uses for the metal are gradually being developed. It is finding its way into lines where it displaces brass; bathroom supply and waste pipes, nickel plated, are at present being manufactured from it, and the demand from this source must eventually be of considerable volume. At the moment, however, its duty is to conserve the tin supply, and this it is accomplished effectually.—From *Engineering and Mining Journal.*





Making the U. S. 8-in. Shell

By M. E. Hoag

III. Boring and Threading Nose

The method of finishing the United States 8-in shell in the Root & Vandervoort shops was planned in such a way as to make use of special tools and machines designed by them at the time they were on contracts for British 8-in. shells.

THE forging operation leaves the nose of the shell rough and slightly longer than required for finishing. It also leaves an opening about 1 in. in diameter, which must be enlarged and bored true to size before threading. The rough-boring of the shell nose is handled on a drilling machine, as shown in Fig. 12. The holders or chucks are of simple construction and are closed by tightening the nuts on the bolt at *A*. Two of these chucks are mounted on a turret base *B*, which is fastened to the base of the machine, and operated by the lever *C* and the locating and locking device *D*. The use of two chucks gives the workman time to unload and reload one while the drill is operating on the shell in the other. The drilling leaves ample stock for finishing, so that no great care is required in order to drill the holes central.

In Operation 10 the shell is chucked in a shell lathe and the nose bored true and reamed to size and faced to length as gaged from the bottom of the shell bore.

Operation 11 is threading the nose for the adapter. For this work a special machine was developed, which uses a straight hob *A*, Fig. 13. The shell is held in an air chuck, and the hob is carried on a spindle in a separate head with suitable adjustments.

In threading, the hob is entered in the work and advanced until the gage *B* touches the end of the shell. The work and hob are then started and the hob fed into the work the proper depth. As the work rotates the hob is advanced a distance equal to the pitch of the thread for one revolution of the work, so that the operation is completed with one turn of the shell and in much less time than could be done with a single-threading tool.

After threading, the adapter is placed in the shell nose and a hardened center plug screwed into this to hold the shell on centers while turning, Fig. 14.

The turning lathe is equipped with a form templet *A* mounted on the back of the lathe in the same manner as a taper-turning attachment, and this controls the form of the shell nose. The tailstock is set in proper relation to this templet, and in placing the shell in the lathe it is located by the gage *B*, the front end of which coincides with the line of contact between the adapter and shell nose. The center in the headstock follows the shell, and is locked in position when the work is properly located. The driver has two driving pins which engage the double dog shown on the work at *C*.

The tools used on the finish-turning operation are of stellite and of the shape shown in Fig. 15. These tools are ground true with the central opening and are given proper clearance and rake. Very heavy holders of steel are provided, with hardened threaded pins to receive the tools, which are bolted firmly to place. One great advantage in this form of tool is that the workman can loosen it and bring a fresh cutting edge into operation without changing the diameter of the finished work and without changing the adjustment of the tool carriage.

As the tool finishes the curved portion of the shell it starts on the parallel portion and is allowed to advance a short distance, as indicated at *D*, Fig. 14, when it is fed into the work sufficiently to secure the finished diameter of the shell body. This leaves the portion at *D* slightly larger than the rest of the shell, and this portion is afterward ground (operation 13) to form what is known as the bourrelet, the diameter of which is a very important dimension, for if too large the shell will jam in the rifling, and if too small it will have a tendency to upset when fired and lose its accuracy.

Operation 14 consists of facing the base and cutting

off the center lug. This is handled in a short shell lathe, the only interesting feature being the way in which the gaging is done. Over each lathe is a jib crane, on which is hung from rollers a scale or steelyard for weighing the shell both before and after cutting off.

The end of the shell is now beveled and the base cover groove turned as in Operation 15. This groove is undercut both ways at the bottom in order to retain

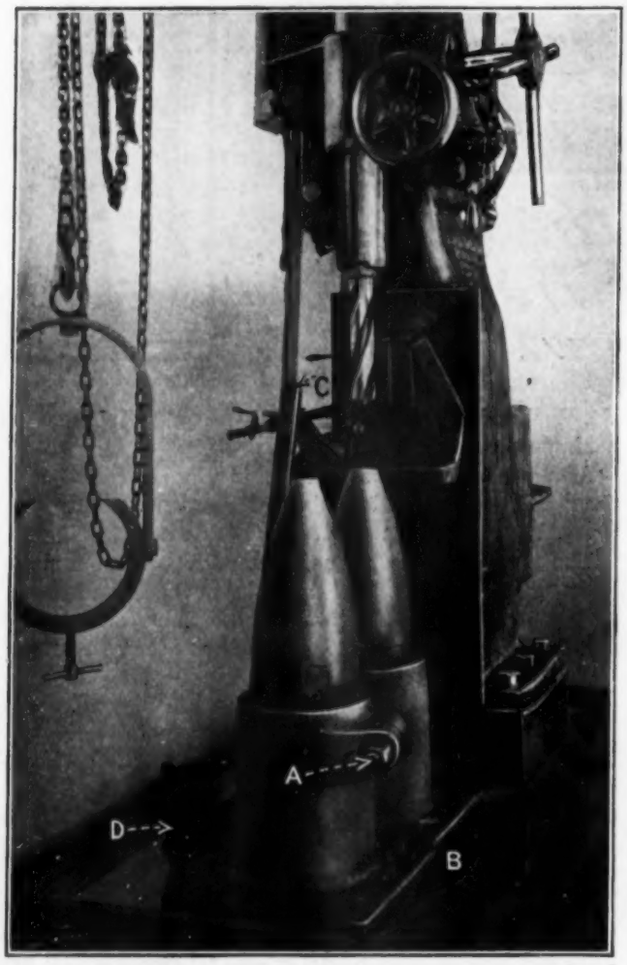


FIG. 12. DRILLING SHELL NOSE

the base cover and gasket when in place, but it is not a difficult operation when handled with a dovetail tool.

Turning and waving the band recess requires the small-tool equipment shown in Fig. 16, two cross-slides being used on a short shell lathe. The rear slide carries roughing tools and the front slide carries a small turret on which are mounted the waving tool *A* and roller *B* and two narrow dovetail tools properly spaced to give the right width to the band recess. These tools are shown at *C*. This slide has a lateral motion, and through the hand lever shown enables the workman to undercut each side of the recess with the dovetail tools which have already sized it to correct width.

The waving tool is broad and is notched for the five waves, the waving motion being imparted to the tool by the hardened cam *D*, which is part of the lathe chuck ring. As the turret is brought into position, the roller *B* bears against the cam and is held in contact by a heavy spring in the holder. This gives the tool a backward and forward motion somewhat similar to a backing-off attachment, and produces the raised

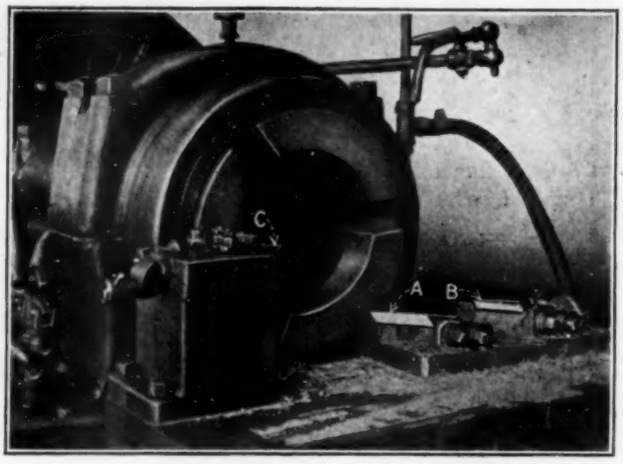


FIG. 19. TOOLS FOR TURNING BAND

waves shown in Fig. 17, which prevent the shell band from turning in the recess.

The shells are next cleaned inside with hot soda solution and live steam, and after inspection are sent to the sandblasting room to be sandblasted inside and then varnished, after which they are given a hydraulic test of 1200 lb. per square inch. Each shell is now swung up by the nose and struck with a hammer. This is known as the "ringing test" for cracks. A good shell will ring clear like a bell, but one with a crack can be readily detected by the sound.

The bands are seamless copper rings and weigh about 8 lb. before being put on. The press for applying the bands is a hydraulic tire setter of standard make and capable of exerting a pressure of over 2000

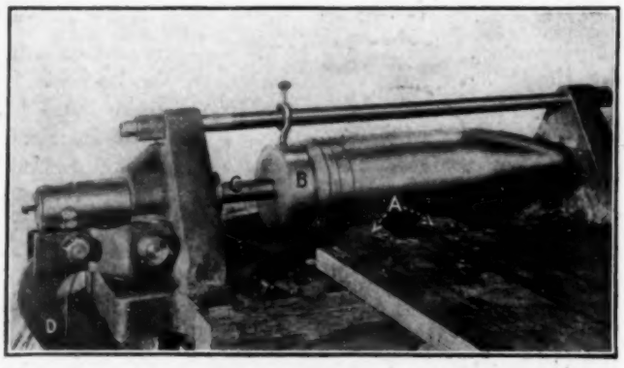


FIG. 21. PRESS FOR APPLYING BASE COVER

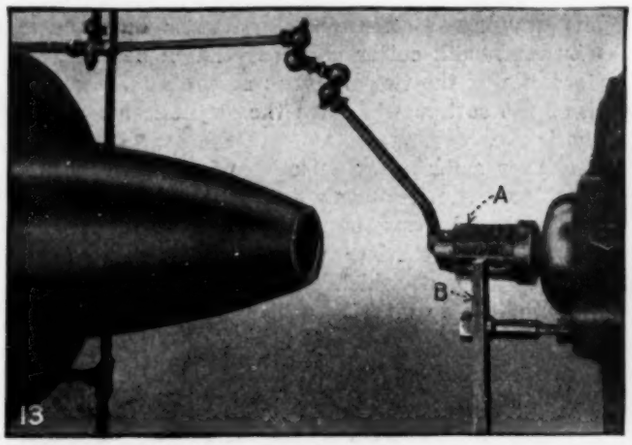
lb. per square inch. Two operators handle this part of the work. One operates the press and the other heats the bands, places them in the press and places and removes the shells, which are swung up by a ringed plug which screws into the adapter.

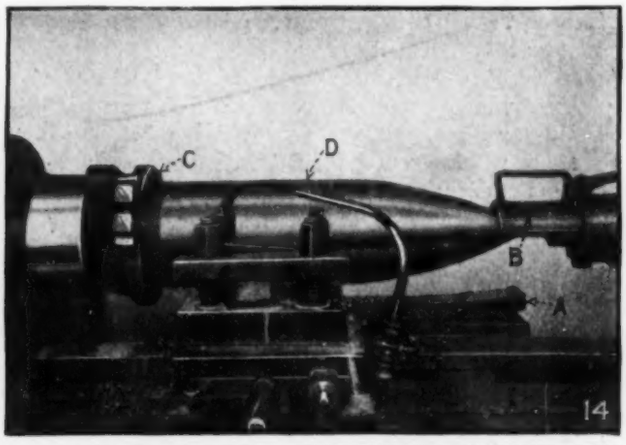
A rest in the bed of the press receives the band and allows the shell to pass through the correct distance to bring the band and recess in line. The bands are heated to about 1700 deg. F., and when they are removed from the furnace they are passed through a jet of gas controlled by a foot lever. This removes

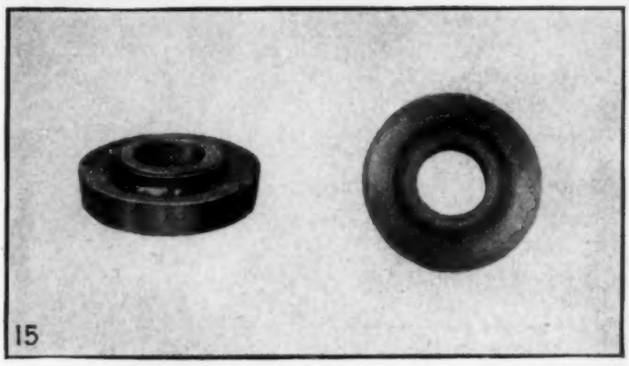
any scale that forms during the heating. The pressure used in applying the bands should not exceed 1600 lb. per square inch.

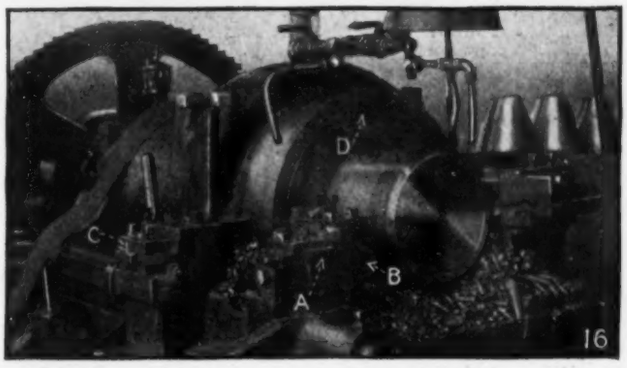
The turning of the bands is handled in the shell lathe, Fig. 19, three sets of tools being used. The tool *A* in the rear slide roughs out the surplus stock and the tool *B* finishes and forms the band to size. The tools *C* in the front toolpost trims the band to width. This leaves the shell as shown in Fig. 20.

The shells are next inspected and weighed, gaged for depth of bore, etc., and the base cover applied with the press shown in Fig. 21. As the shell is passed along the wooden platform it drops into the V-blocks *AA*.









FIGS. 13, 14, 15, 16, 17, 18 AND 20. OPERATIONS ON SHELLS

Fig. 13—Thread shell nose. Fig. 14—Finish turning. Fig. 15— Stellite turning tools. Fig. 16—Turning and waving band recess. Fig. 17—Shell after grinding bourrelet and recessing. Fig. 18—Band pressed on. Fig. 20—Shell with band finished

The base cover consists of a flat lead disk of a diameter equal to the inside diameter of the base cover groove; a copper disk, the edges of which are pressed up at right angles and enter the groove in the shell base; a narrow lead gasket, which is pressed in between the copper and outer edge of the groove or recess, this work all being done before the shell reaches the press shown. The block *B* is fitted with a plunger which protrudes a short distance, and is backed up with heavy springs in a manner similar to a stripper plate on a die. When air is admitted to the cylinder under the press the ram *C* is forced forward by the toggle lever *D*. This brings the plunger in the block *B* against the copper disk and seats it and the lead disk under it firmly against the shell base. As the pressure is increased, the plunger recedes and the rim of the block *B* presses the lead gasket into the recess and locks the base cover firmly in place.

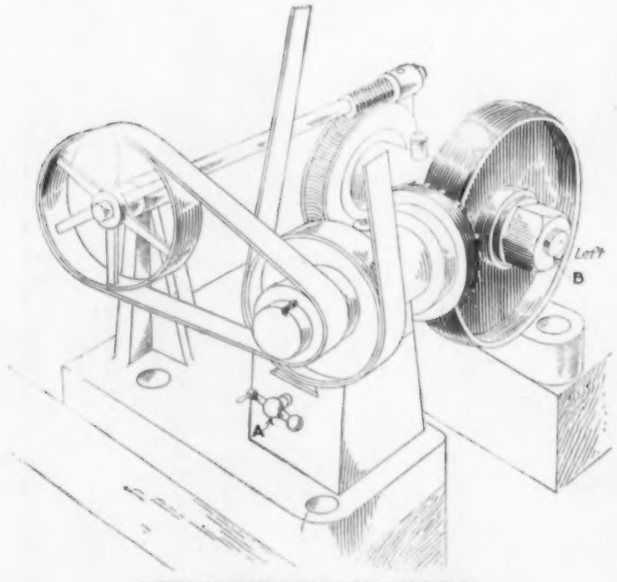
A paraffined wooden plug is screwed into the adapter and the shell passed to the shipping department, where it is fitted with a fiber band to protect the copper band, painted with a slush or varnish to prevent rust and boxed ready for shipment.

Milling Pulley Faces

By J. A. Lucas

In a shop the line of manufacture of which included large quantities of cast-iron pulleys, the turning of the crown face got to be a considerable item of labor expense, as it was a slow operation and required closer attention because of the crown.

A fixture, or machine, like that shown in the cut was made, and its success was immediate.



DEVICE FOR MILLING PULLEYS

Except for changing the pulleys and starting the cut the machine takes care of itself, and having finished a pulley (which it does in one revolution) it will run merrily along without damage until somebody gets ready to put on another casting.

It was made the duty of everyone, from the floor sweeper up, whenever he passed one of the machines that was running idle to take off the finished pulley and start a new one. Thus the labor cost was brought to a very low figure as the changing would almost always be done by someone who was waiting for a cut to run out on the milling or planing machine or by someone who for one reason or another could spare a moment without interfering with his regular work.

The drawing is self-explanatory. The diameter of the inserted-tooth cutter and the relation between the center lines of the two shafts is so computed that the path of the cutters will leave the requisite amount of crown.

Whenever a man sees a machine idle and he has a moment to spare he simply turns back the handle *A* a turn or two, loosens the nut *B*, takes off the finished pulley, puts on a casting and runs up the cutter again to a fixed stop, at which time it is cutting the full depth required to size the pulley.

Finish-Turning With Stellite

By P. P. Hale

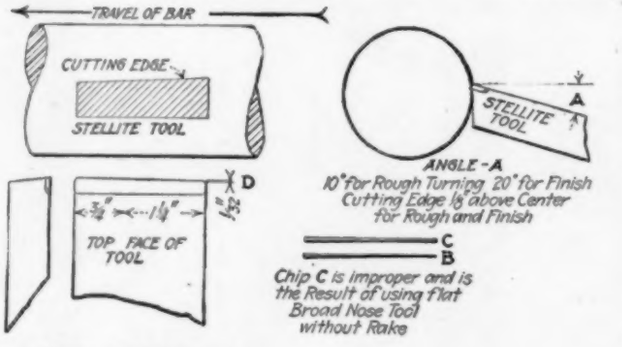
Sales Engineer Haynes Stellite Co.

It is generally conceded that Stellite is not adapted to finish-turning steel shafting of any description. We have found lately, however, that we can produce an excellent finish at much greater speed than any other tools known, the sketch showing how the operation was accomplished.

All of the particulars outlined are essential, as by eliminating any one of them it is impossible to get the proper results.

First we took a very broad-nosed tool, set the cutting edge about $\frac{1}{8}$ in. above center, giving it an angle of about 10 deg. for rough-turning and 20 deg. for finishing-turning. We did this on an ordinary shaft-turning lathe, the tools being 2 x $\frac{5}{8}$ x 4 in., using our No. 2 Stellite at a surface speed of 97 ft., depth of cut $\frac{1}{32}$ in. and feeding 3 ft. per minute, turning six 30-ft. shafts to a 0.001 in. limit with one grind.

To produce this result we tapered the tool back, as shown at *A*, giving it $\frac{1}{32}$-in. taper about 1¼ in. back. This leaves the tool cutting the full 1¼ in. and dragging


TRAVEL OF BAR
CUTTING EDGE
STELLITE TOOL
STELLITE TOOL
A
ANGLE - A
10° for Rough Turning 20° for Finish
Cutting Edge ⅛" above Center
for Rough and Finish
D
TOP FACE OF TOOL
C
B
Chip C is improper and is the Result of using Flat Broad Nose Tool without Rake
RECORD OF PERFORMANCE
Work - Open Hearth Steel Shafting
Machine - Shaft Turning Lathe
Tool - 2 x ⅝ x 4 Stellite No. 2
Surface Speed - 97 Feet
Depth of Cut - 1/32"
Feed - 3 Feet per Minute
Remarks - Six-30 Feet Shafts turned to 0.001" Limit with one Grind
To get the required Polish and hold Shaft to Size Edge of Tool must taper back towards Center as shown at D so that back Side of Tool takes a very Light Shaving Cut turning Chip as shown in B

ARRANGEMENT OF TOOL AND WORK

the other $\frac{3}{4}$ in. with a side rake sufficient to cut a chip shown at *B*. We found that the shape indicated at *C* was incorrect and was the result of using a flat, broad-nosed tool.

XIII. The Barrel—II.

The operations included in this installment are the chambering, lapping, inspecting and so on. The tools for forming the chamber, including machine and hand reamers and other devices, are illustrated. The inspection gages for testing various parts of the work are also shown.

RETURNING to the barrel work there are a number of operations following the grinding and gaging of the taper, such as grinding the hub end, circular-milling the end, leaving the location lug to be finished in rough and second operations in the shaper. Then the barrel end is thread-milled to fit the internal thread of the receiver.

This process need not be described here, and as the character of the fit of the barrel and receiver thread has already been described in the article on receiver manufacture it is not necessary to enter into a repetition of the accurate relationship demanded and maintained between these two parts.

However, a word about a few of the special gages applied to this part of the work may well be included here. Fig. 109 is a ring gage which serves as a thread-length gage. This gage is provided with a rectangular opening at one side which fits the locating lug formed on the top of the barrel and comes up against the narrow shoulder on the barrel hub immediately behind the lug. This locates the ring gage so that a narrow projecting arm *L* which extends to the rear is held in a definite position in respect to that lug so that when another gage—a thread gage—is screwed onto the thread a slotted latch which it carries will swing down and inclose the arm *L*. This arrangement tests the relationship of the thread on the breech end with the locating lug, for any error in position of the thread on the barrel will make it impossible for the thread gage to set up properly and allow its slotted arm to receive the straight arm on the ring gage at *L*. This gage combination will be referred to again at the point where all the test gages are included in one group.

One more gage used in connection with the barrel-threading operations may be mentioned here, namely, the thread gage, Fig. 110, used when hand-milling the end of the thread. This gage has a straight bore at the inner end to allow the ring to screw up against the rear face of the narrow shoulder on the barrel hub, while the threaded interior portion fits snugly on the barrel thread. The gage is of the proper length to correspond to the distance from the outer end of the thread to the shoulder on the barrel hub. The rear face of the gage is slotted crosswise, or notched, as indicated at *M*, leaving a horizontal edge which when the gage is screwed up snugly by hand should stand just a slight distance below the extreme end of the barrel thread as milled off in the hand machine. Thus when the gun barrel is screwed into the receiver there will be a slight but definite allowance which enables the barrel to be positively screwed up snug and fast in the receiver.

In the actual assembling of the gun the part known as the radiator-casing locking piece fits over the barrel hub against the narrow shoulder used in the different gaging operations described. Consequently all the gages that seat against the shoulder in the test processes are made to allow for the exact thickness of the locking piece so that the conditions under which the gages are used duplicate those that would exist if the locking piece were actually in place at the time.

With the thread finished and the muzzle end also threaded to receive the mouthpiece the barrel is ready for the chambering operations which are performed in machines of the type in Fig. 111 with the aid of the

tools represented by the detail drawings Figs. 112 and 113. These drawings of the chambering tools show two sizes only, that is, the first and third machine roughing reamers; but the second, or intermediate machine-chambering reamer, is similar in character and comes about midway between the other two in size. It is usually formed by reducing a worn reamer, No. 3, to intermediate size and operating it between No. 1 and No. 3 chambering reamers. All three reamers will be noticed in place in the horizontal turret of the chambering machine in Fig. 111. The two other turret tools shown are for facing the breech end to gage.

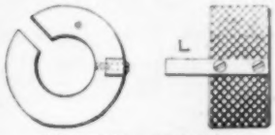


FIG. 109. THREAD-LENGTH GAGE

The first machine chambering reamer, Fig. 112, is made, as illustrated, with three flutes and with a left-hand helical groove running the length of the taper-cutting portion. The outer end of the reamer is made with a reduced taper portion on account of the bottle-

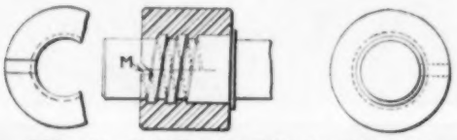


FIG. 110. GAGE FOR END OF THREAD

neck chamber required for the cartridge case, and the extreme end of the tool is finished to a small diameter to receive a pilot shell.

The body of the tool is cut with a fine thread for adjustable stop collars which positively limit the depth to which the reamer may be fed into the breech during the operation.

The second and third reamers are made as in Fig. 113 with four flutes each, and they have the same pilot-

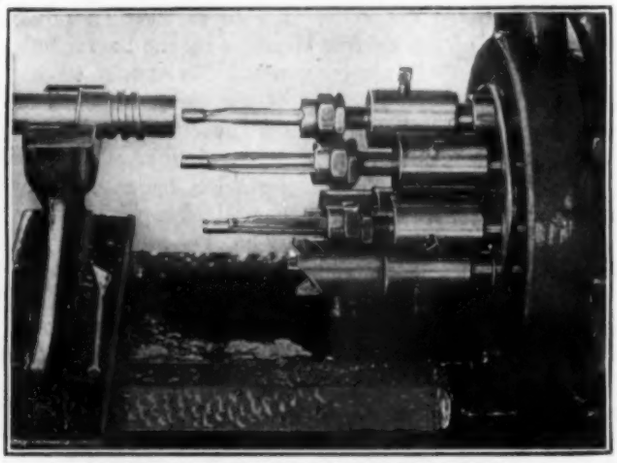


FIG. 111. CHAMBERING THE BARREL

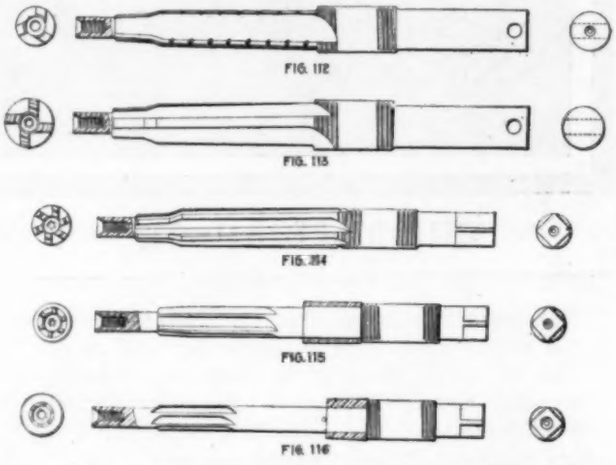
shell and stop-collar arrangement as the roughing reamer described. These reamers are made with plain taper-cutting edges without the helical notches along the teeth, but their flutes are cut spirally. Thus in both cases of roughing and finishing machine reamers provision has been made to obviate the tendency on the part of the reamers to feed too greedily into the work as they otherwise might do on account of the easy taper. This would, of course, cause much spoiled work and the breakage of reamers.

The hand reamer, Fig. 114, is made with six teeth and the flutes are milled left-hand spiral. Like the machine reamers the hand tools also have stop collars to limit their depth of operation in the chamber of the barrel.

The Necking and Throating Reamers

The hand-necking reamer, Fig. 115, is made to finish only the short portion of the chamber between the straight-tapered main portion and the smaller throat leading into the bore proper, and for this operation it is guided at the front end by the pilot on its reduced point, and at the back by a tapered bushing which fits the mouth of the chamber. The flutes along the main portion of the necking reamer body do no cutting, the work being confined to the short, abrupt taper at the front end.

The hand-throating reamer, Fig. 116, has only one portion of the work to perform, and that is the finish-



FIGS. 112 TO 116. SOME OF THE REAMERS

Fig. 112—First machine-chambering reamer. Fig. 113—Third machine-chambering reamer. Fig. 114—First hand-chambering reamer. Fig. 115—Neck reamer. Fig. 116—Throating reamer.

ing of the throat leading immediately into the bore proper, which has a very slight taper. Like the neck reamer, the throating tool is supported and guided at the front and back ends by bushings which fit the work properly and hold the tool perfectly central.

Following the chambering operations described there are a few small machine cuts to be taken on the barrel, including circular-milling around the cartridge stop, milling the bullet clearance at the mouth of the chamber (both hand-milling operations), then certain hand operations in filing and facing the cartridge stop to gage, and running a hand die over the fine thread on the muzzle to receive the barrel mouthpiece.

Operation No. 42 (machine leading of the barrel) consists in passing lead laps back and forth through the rifled bore to remove all traces of burrs along the edges of the rifling, and while noted as Operation 42 on the list it may be performed, if desired, before the barrels are sent to the grinding machines for finishing the outside taper surface, as the interior is not touched in the grinding process, the work being held in the grinder on short plugs fitted to the ends of the barrel.

In any event the work of lapping, or rather leading, as referred to is carried on by making for each barrel

a short lead lap which is a cast of the rifled bore and which is attached to a rod in a reciprocating machine for sliding the lap to and fro along the rifled grooves.

The machine is constructed to handle four barrels simultaneously, and from 5 to 10 minutes is required for each group of four barrels passing through the leading process. The lapping rods are passed to and fro, each lap carrying a charge of fine emery and oil for the operation.

Lapping the barrel, hand-tooling the gas port and a few other hand operations are followed by a final straightening operation.

The gages used in the inspection of the barrel are illustrated by Fig. 117. A set of inspection plugs is seen in the block *A* in the background, these plugs being so made as to independently test various portions of the chamber in the barrel, including the chamber proper, the neck, the throat, the bore, etc. They are constructed with micrometer heads, and any departure from true depth or diameter is readily detected and any inaccuracy is located by the plugs which test one portion only of the chamber.

The two female-thread gages at *B* are the limit gages for the fine thread on the muzzle end of the barrel. The gage at *C* is a micrometer tool for testing the accuracy of the 60-deg. mouth of the gas port in the under side of the barrel, the gage for the port itself being shown at *D*.

The gage *E* has already been described in connection with the drawing, Fig. 109. Gage *F* is for testing the end of the thread in connection with the gage shown in Fig. 110 which shows the tool in plan and section.

At *G* a gage is illustrated which serves as a qualifying tool, the interior being threaded and ground to fit the barrel thread for the receiver and to screw up against the shoulder on the hub of the barrel. In this position the pivoted and channeled finger which it carries must swing down and just pass over the locating arm on the other gage which fits over the lug on the barrel as previously described.

The ring gage *H* is virtually a testing tool for the thread and for both cylindrical portions of the barrel end where it enters the receiver, and supplies means for a rigid test of the surfaces mentioned both as to diameter and concentricity of the three portions.

It is made in two sections. One, the main body, embodies the thread and the fit for the large diameter on the barrel. The other, a thin ring, gages only the small diameter. The sectional construction allows the gage to be made with great accuracy and naturally it requires very careful workmanship when put together. The thin section or ring is located in place by three dowel pins and secured by three small fillister-head screws. The dowels instead of entering directly into seats in the longer ring are fitted into bushings.

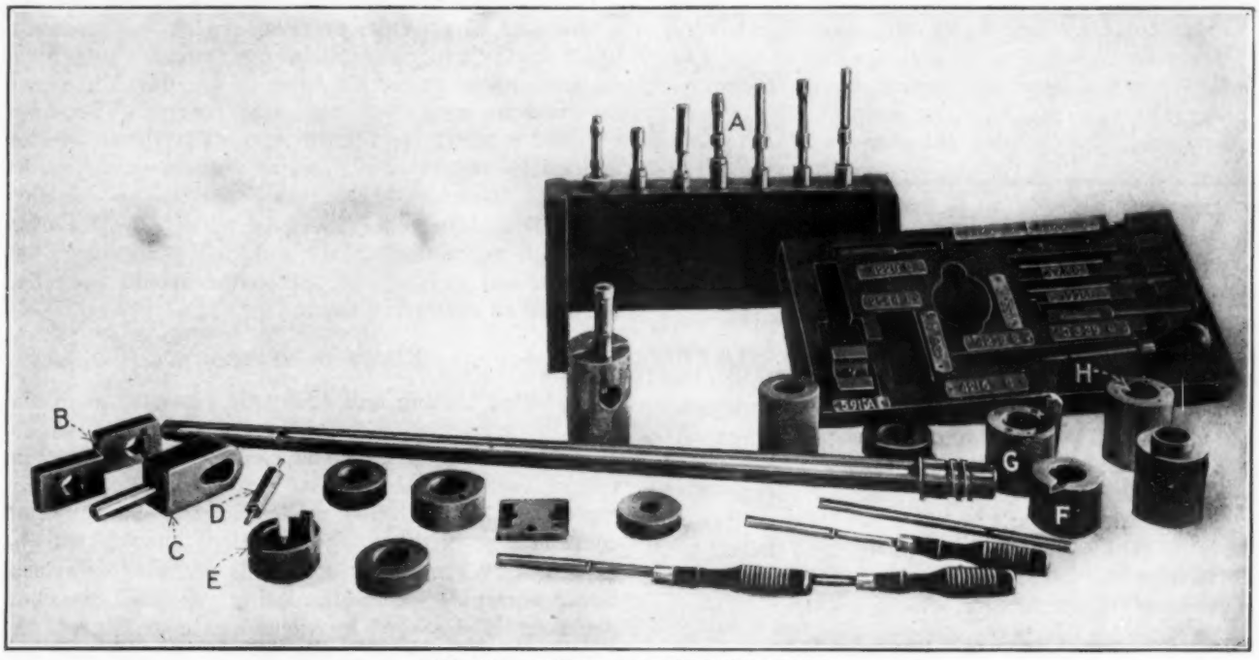


FIG. 117. GROUP OF TESTING GAGES

Eight-Hour Day at Bethlehem Steel

The statement made public under the authority of the National War Labor Board on Aug. 4 with respect to the board's findings in the case of the Bethlehem Steel Co., made it appear that the basic eight-hour day was in effect throughout the company's plant at Bethlehem, Penn. In this regard the statement was in error, since the application of the basic eight-hour day was not included in the finding. The basic eight-hour day does now and has applied in the machine shops at Bethlehem, but it does not apply, under the War Department's interpretation of the eight-hour law, to branches of the plant engaged in producing steel billets, rolled-steel or other unfinished products for the open market. In these branches at Bethlehem the present workday remains unchanged under the findings of the board, the only action of the board with regard to the basic day being to declare that overtime beyond the usual workday should be compensated for at the rate of time and half time; that work on Sundays and holidays should be paid for at the rate of double time and that in the fixing of piece rates provisions be made for overtime payment as now provided in the case of time workers.

How to Buy Direct-Current General-Utility Motors

By A. BRUNT
Engineering Department, Westinghouse Electric and Manufacturing Co.

Lack of judgment in writing the specifications for motor purchases for direct-drive work can cause trouble to the purchaser either by underpowering his installation or in the case of motors that are too large by causing an unnecessary investment of capital. The writer makes some pertinent remarks upon the phases of this topic.

WHEN buying electric motors the purchaser should know as exactly as possible the power requirements of the application. The motor should be neither too small nor too large. The first may result in trouble, whereas the second represents a waste of capital. In specifying the size of motor for a given purpose the practice generally is to calculate or otherwise determine approximately the required horsepower, and after that add an appropriate percentage as a margin of safety to take care of possible overloads. This practice, however, fails to take advantage of the valuable overload capacity of direct-current motors, and the intelligent buyer of them should be familiar with the factors that limit the horsepower output that can be obtained from the motor.

Allowable Heating

In addition to requiring specific speed characteristics determined by the nature of the application, high efficiency and satisfactory mechanical and insulation strengths, the motor should, under ordinary operating conditions, not exceed certain limiting temperatures, and it should commutate satisfactorily. Heating, caused by losses due to the transformation of electrical into mechanical energy, and commutation are the factors that limit the output from any direct-current motor.

In regard to allowable heating, direct-current motors for continuous service can now be bought under two different specifications: (1) Motors rated to develop their normal horsepower continuously with a temperature rise not to exceed 40 deg. C. on armature and field windings and 45 deg. C. on the commutator, in addition to which temperature rises at the end of a 25-per-cent. overload run for 2 hours following the full-load run should not exceed 55 deg. C. on the core and windings and 60 deg. C. on the commutator. (2) Motors rated to develop their normal horsepower continuously with a temperature rise not to exceed 50 deg. C. on armature and field windings and 50 deg. C. on the commutator (single rating). In each case a momentary overload, usually of 50 per cent., without injurious sparking is guaranteed.

The first specification should apply to motors that are subject to extended overloads, as for instance in the line-shaft drive, certain pump applications or others, while the second, which is coming into more general use, should be applied where the characteristics make an extended overload impossible, as in fans and blowers, printing presses, certain centrifugal-pump applications, conveyors, etc.

It is obvious that the first specification allowing for a two-hour 25-per-cent. overload should find more application for generators than for motors. In central stations, where at certain times of the day a one-hour or two-hour peak load regularly occurs, a two-hour overload capacity is of much more value than in motor aplications where an overload occurs occasionally. However, if motors are bought under this specification no additional margin should be provided by adding a certain percentage to the required horsepower, but the overload capacity of the motor should be relied upon for all emergency cases.

Excessive Heating

Excessive heating will gradually destroy the insulation of armature and field coils and will lead to electrical grounds and burn-outs. The maximum temperature to which the materials in a motor, especially the insulation materials, may be subjected continuously without deterioration should not be exceeded. When the safe limit is exceeded deterioration is rapid. The insulating material becomes permanently damaged by excessive temperatures, the damage increasing with the length of time that the excessive temperature is maintained and with the amount of excessive temperature. Thus the result of operating in excess of the safe limit is to shorten the life of the insulating material. The standardization rules of the American Institute of Electrical Engineers allow a maximum temperature of 105 deg. C. for cotton insulation, usually employed in direct-current general-utility motors, which figure is based on extensive tests. On the basis of a room temperature of 40 deg. C. and an allowance of 15 deg. C. between the temperature observable by thermometer and the temperature actually prevailing internally (called the hot-spot correction) the maximum allowable observable temperature rise should not exceed 50 deg. C. This temperature rise forms the basis of the single rating.

While operation in excess of safe heating limits will cause rapid deterioration of the insulation, operation in excess of the commutation limit will cause rapid wear of the commutator and brushes with a consequent high maintenance cost. In motors of the sizes used for general-utility service, however, the commutation limit is considerably beyond the heating limit, so that in a well-designed motor no commutation trouble need be experienced if the motor is worked inside the heating limits. For direct-current motors and generators of larger capacity (250 hp. and up) heating and commutation limits approximately coincide, while for the largest direct-current machines commutation limits the obtainable output. This, of course, is only a rough outline of output limitations, the speed, for instance, being another important consideration. With increasing

speed, ventilation becomes more effective, making it possible to dissipate a larger amount of heat, whereas commutation difficulties increase. Sparkless commutation with fixed brush position up to full load is readily obtained and no injurious sparking should be observed during the two-hour 25-per-cent. overload run or during a momentary overload of 50 per cent. or more, if the application requires this excess.

No unnecessary increase in the size of the motor for a certain application should be forced by specifying sparkless commutation up to 50 or 100 per cent. overload, as the case may be, where this overload may occur only occasionally. Even if the motor does spark somewhat at these overloads no harm will be done if

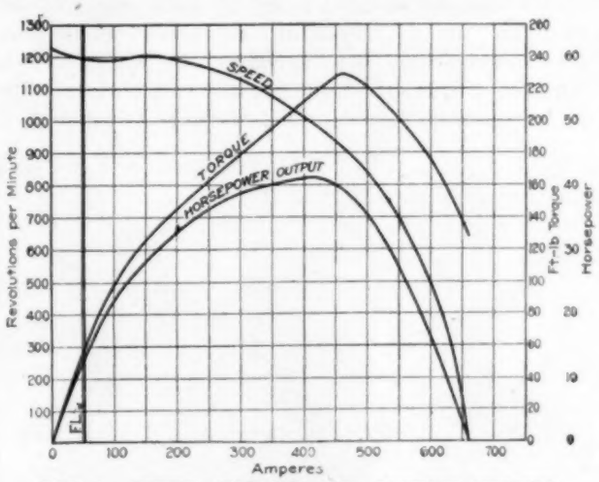


FIG. 1. SPEED, TORQUE AND OUTPUT CURVES

in the intervals between the overloads the motor runs at normal load or less, thus getting an opportunity to keep the commutator in a polished condition.

In order to give an idea of the remarkable overload capacity of the direct-current motor Fig. 1 shows the characteristics of a modern 10-hp., 230-volt, 1200-r.p.m.

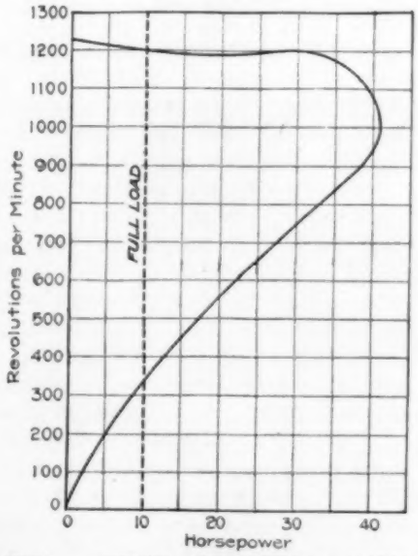


FIG. 2. SPEED AND OUTPUT CURVE

shunt-wound motor. These curves show that the maximum obtainable torque is 5.2 times the normal torque, and the maximum output 4.1 times the rated horsepower. This should not be understood to mean that it will be wise to subject the motor to these overloads, but it does show what a reliable standby the direct-current motor is in case of emergency. Even if excessive temperature does affect the insulation, and a high overload may cause some sparking, permanent damage will not result from a momentary, or short-time, overload in an emergency case. Fig. 2 gives the speed as a function of the horsepower output for the same motor, and it shows that up to 300 per cent. load the speed is practically constant, a characteristic that is all the more remarkable if it is considered that it is obtained without any adjustments whatever. The contrast between these characteristics and those of the gasoline engine, reciprocating steam engine and steam turbine is very striking. The torque obtainable from a gasoline engine is practically determined by the cylinder cubic contents and it cannot be increased beyond that value; the reciprocating steam engine is subject to some adjustment for overloads by variation of the cutoff, and the steam turbine will carry very little load in excess of the load for which it is built, and the only way to produce overload capacity is to increase the steam pressure at the time of the overload. These facts perhaps partly explain the tendency on the part of motor purchasers to play safe in specifying the rating of a direct-current motor.

The possible overloads given in the preceding paragraph are well within the limits set by the mechanical strength of shaft and bearings, which for the average

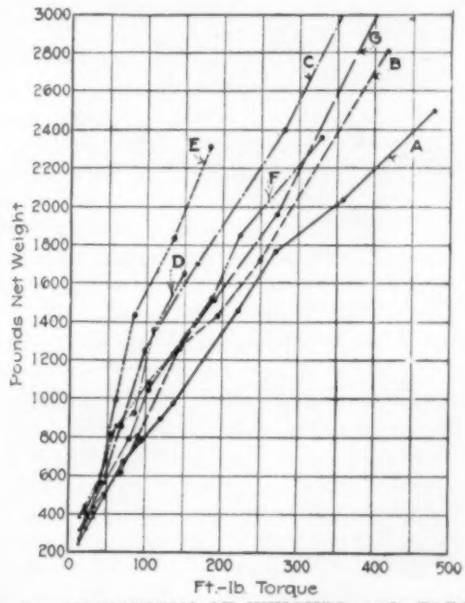


FIG. 3. COMPARISON OF WEIGHTS AND TORQUE

motor will have a factor of safety of from 10 to 15. Also overload figures, of course, vary with the size of the motor, being somewhat smaller for smaller motors and larger for larger motors.

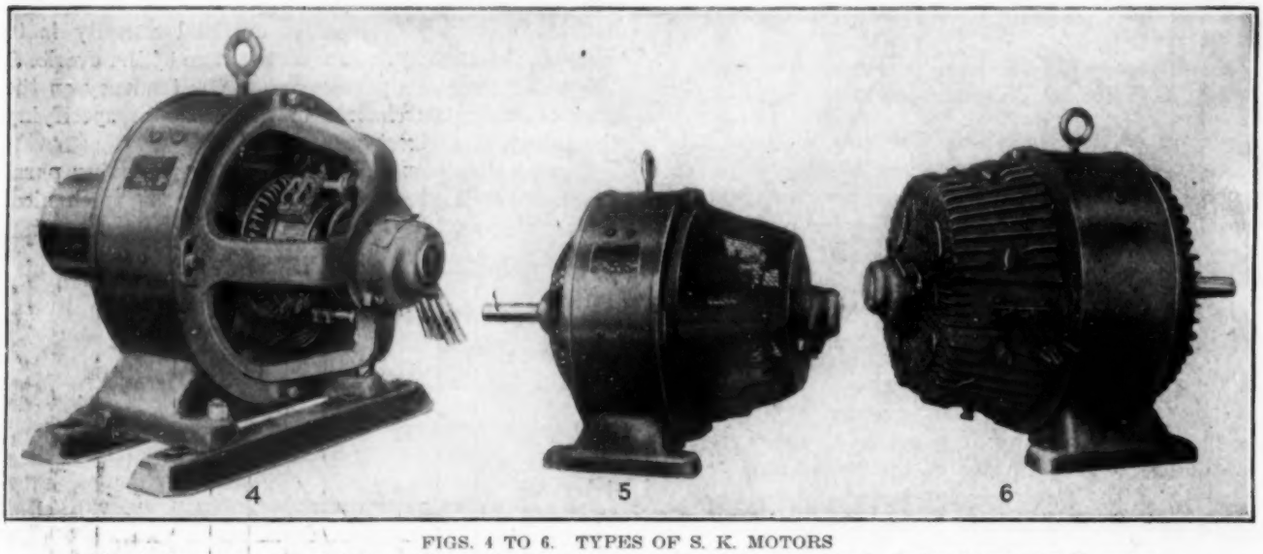
The adoption of the 50-deg. C. temperature rise as the basis of direct-current motor ratings has been brought about by the recognition of the fact that no advantage is obtained by designing motors so that the temperature is lower than the temperature the insulating material will stand continuously without deterioration. Since the single-rated, 50-deg. motor is lighter and lower in price than the 40-deg. motor the use of 40-deg. motors for applications not subject to overloads represents a waste of capital and valuable

material. Not only should the lighter 50-deg. motor be bought wherever the nature of the application warrants it, but out of a choice of motors designed on the same temperature basis the lighter motor has several advantages over the heavier one, the most important of which is that the lighter motor must be the better ventilated one, and thus for the same measured surface temperature rises must have lower internal temperatures. [Note—See the author's articles in *Electric Journal*, December, 1917; *Electrical World*, Feb. 16, 1918.] That the variation in weight between direct-current motors of different makes is very considerable is well illustrated by the curves of Fig. 3, which give the weight as a function of the torque for direct-current motors manufactured by seven different companies in this country.

When purchasing direct-current motors careful thought should be given to whether they should be specified to be open, semi-inclosed or totally inclosed.

In case of necessary protection against drip water the top half of the semi-inclosing covers can be made of solid sheet material, leaving the bottom half semi-inclosed or open. This construction reduces the output to approximately 80 per cent. of the output of the open motor. Because the best rating can be obtained with open motors this construction should be used wherever possible, especially in clean rooms and where skilled tenders are available. It is much better to buy open motors and have sufficient tenders to keep them clean than to buy motors of inclosed construction for the purpose of keeping out dust and dirt.

Sometimes the purchaser of motors submits elaborate specifications to the manufacturer. Frequently he goes to much expense to have a set of such specifications drawn up by a consulting engineer. Sometimes these specifications are harmless, as they include things the purchaser would get anyway, such as "the coils to be securely held in slots accurately punched in



FIGS. 4 TO 6. TYPES OF S. K. MOTORS
Fig. 4—Open type of S. K. Motor. Fig. 5—Semi-inclosed type of S. K. motor. Fig. 6—Inclosed type of S. K. motor.

Any degree of inclosing obstructs the ventilation, and thus for the same output necessarily causes greater temperature rises, or for the same temperature rise as for the open motor reduces the rating. Figs. 4, 5 and 6 show an open, semi-inclosed and totally inclosed motor respectively. Whereas the obstruction to the ventilation caused by the semi-inclosing covers as illustrated in Fig. 5 is so slight as not to require a reduction in rating, the totally inclosed construction reduces the output to from 50 to 65 per cent. of the open rating even if the ribbed end bracket construction materially increases the cooling surface (Fig. 6) and thus increases the allowable amount of losses and the obtainable rating. Totally inclosed motors further can only be built for moderate speeds and ratings. If it becomes necessary to have a totally inclosed motor of high rating or speed the only way to obtain it is by forced ventilation; that is, to pipe cooling air to the motor from a separate supply source.

Semi-inclosing covers are used to protect the motor against foreign matter, as, for instance, chips of metal in machine-tool service, or to protect the tender against coming in contact with the live electrical parts. The safety movement has led to a large increase in the demand for semi-inclosed motors.

the circumference of the laminations," or "the armature to be built up of thoroughly insulated laminations," or "commutator segments to be made from the best quality of hard-drawn copper," or "current density of carbon or graphite brushes not to exceed a certain value," etc. By buying from a reputable manufacturer such specifications are needless, as he will guarantee the motor to do the work, and his expert designing engineers know much better how to obtain the desired results than do consulting engineers who only handle such matters occasionally. A reputable manufacturer cannot afford to take chances on the failure of motors to do the work that is expected of them. Sometimes, however, such specifications can do harm in that they require special motors or motors that are larger than needed to do the work. For instance, a too low temperature rise, an unreasonable overload requirement, or a too low brush current density is sometimes specified.

It is to the advantage of purchasers to buy motors that are of the manufacturer's standard in every respect. They will be able to buy such motors at a lower price and for shorter deliveries than apply to special motors, and they will be able to get much better service in case they find it necessary to order repair parts.

Temporary Small-Arms Repair Shop in France

By R. K. TOMLIN, JR.

PENDING the completion of the steel-frame structure, Fig. 1, which will serve as the machine shop and repair plant at the Advance Depot of the American Expeditionary Forces in France, a temporary small-arms repair plant has been in operation since Mar. 10. It is on a very small scale and is intended merely to tide over the gap until additional space in the permanent structure will become available. The illustrations, Figs. 2 and 3, taken from opposite ends of the demountable wooden shed which houses a force consisting of a major, a lieutenant and ten men, give an idea of the layout. The specific work now in progress is the repair of defective rifles sent back from the front and the recovery of usable spare parts. Later the operations will be expanded to include the handling of broken revolvers, machine guns, sabers and bayonets.

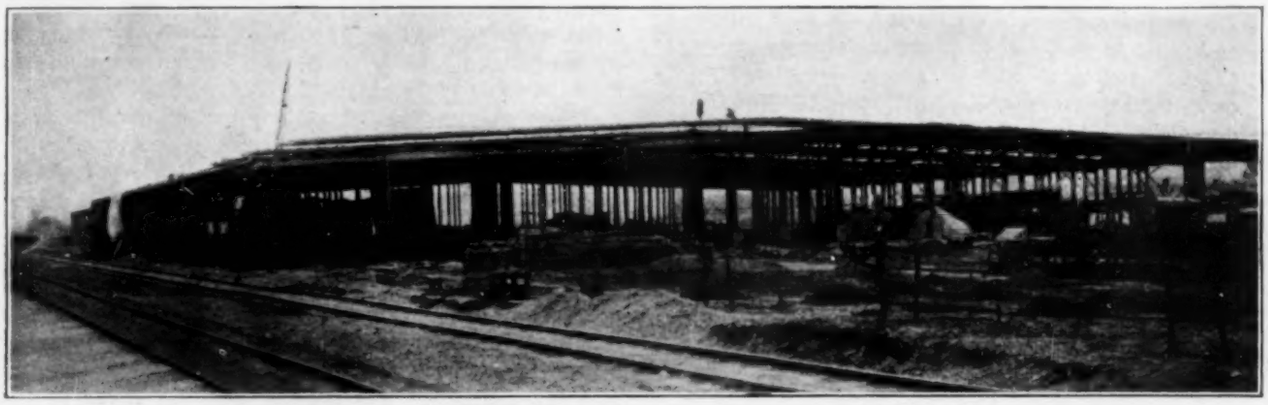


FIG. 1. REPAIR SHOP IN COURSE OF CONSTRUCTION

After the wooden shed had been built it became necessary to provide means for boiling rifle barrels in a 20-per-cent. solution of sal soda and water. With practically no construction facilities at hand there was built a concrete stove, using an old nail-keg as a form for molding the fire-box. This primitive stove was roofed over by a piece of tarpaulin supported by stacks of empty ammunition boxes.

When a lot of defective rifles are received they are disassembled and the metallic parts given a thorough washing in the hot soda water. The stocks go directly to the shop for inspection. The washed rifle barrels and accessories pass to the work benches where all parts are segregated in boxes with sectional compartments—one compartment for parts of the same kind. The sights, however, are not removed. All parts are then carefully inspected, the undamaged ones being retained for reassembling and the defective ones being repaired or sold as old metal. Rifle barrels are cleaned, inspected and then finished with an application of sperm oil to prevent rust.

Rifles are assembled from the parts recovered by this process of inspection and repair. The trigger pull is adjusted to the standard four-pounder and tested by a weight. As a final test two head-space gages, in the form of solid steel shells, a minimum and a maximum,

FIGS. 2 AND 3. TEMPORARY REPAIR SHOP (VIEWS TAKEN FROM OPPOSITE ENDS)

are inserted successively in the firing chamber. The breach must close on the one and jam on the other.

After the reassembled rifles have passed these inspection and gaging tests they are packed in wooden chests for reissue. The recovery of spare parts is carried to the most minute detail.

Between Mar. 20 and Apr. 4 the ordnance major formerly stationed at the Springfield Arsenal, the lieutenant and the force of 10 men have handled 1100 rifles at this temporary repair shop. When the permanent steel structure is ready for occupancy the force will be greatly expanded and it is probable that the bulk of the spare-part recovery and inspection work will be done by French women. The temporary plant, however, it is claimed, is one which could readily be set up and operated by an army division in the field, thus relieving the central plant of a certain amount of small repair work.

Saving Coal by Efficient Pulleys

BY CHARLES H. MACHEN

The surprising experience during the past winter of having to shut down our manufacturing plants to save sufficient coal to supply our ships to carry the much-needed food and war material for our allies and our troops abroad, has forcefully brought to our attention the scarcity of fuel and the need of saving it wherever possible.

MANY interesting problems are being forced on us today as a result of the war, and the solving of these is bound to have the effect of making us both individually and collectively more efficient. While we have been wasteful to the extreme in the past we must now conserve energy wherever possible.

The shortage of coal all over the world naturally has had the effect of increasing its cost. In Italy it sells for $125 a ton, and as a result any device that will actually save coal assumes an importance of the greatest magnitude. What we propose to discuss is of interest because it is a power-transmission device that in many cases will actually effect a saving of over 10 per cent. in the cost and consequently in the quantity of fuel required by manufacturing plants, besides meeting every requirement of efficient mechanical power transmission.

It is well recognized in factories and mills where power is transmitted by means of belts and pulleys that there is a huge loss of power due to the slipping of belts on the pulleys, and it is also well understood that the "belt slip" slows down the speed of the machines, thus decreasing the output. Prominent engineers, authorities on the subject, have stated that the losses due to slipping belts frequently amount to as much as 30 per cent. of the power generated. As belts and pulleys have come down to us from the early days of steam power we have been inclined to accept them as they are, disregarding the losses, and to confine our efforts to check power leaks elsewhere by improving the efficiency of the machines.

There has been another reason for this apparent willingness to overlook such vital losses, and that is that the loss is not apparent to the eye of the observer.

The efficiency of a boiler, of a dynamo, of a motor or of a machine is readily tested, and they are generally bought based on specific specifications as to their efficiency; but with belt pulleys and belts there has been little in general known about their efficiency due to the fact that there have been few laboratories equipped to test them. The data that we will give will point to the possibilities of such important and necessary savings in fuel that we hope they may lead manufacturers to look into their power-transmission equipments and see if there is not room for improvement in their efficiency.

One of the most complete series of comparative tests of belt pulleys was made by a firm of consulting engineers, Haven & Crosby of Boston. In their report covering their findings, they showed that while a cast-iron pulley of a given size and tested under given conditions had a belt slip of 5 per cent., a steel pulley of the same size and tested under the same conditions had a belt slip of 2.65 per cent. In other words there was a difference in favor of the steel pulley of 2.35 per cent. In another series of tests of a pulley of a larger size the difference was 2.7 per cent. in favor of the steel pulley as compared to the cast iron. In every case the cast-iron pulley had a belt slip nearly 100 per

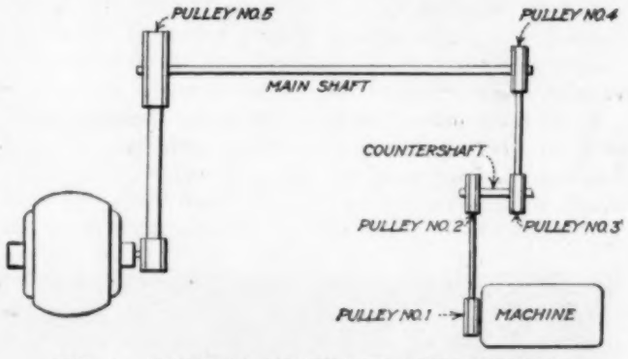


FIG. 1. DIAGRAM OF PULLEY ARRANGEMENT

cent. greater than that of the steel pulley. These differences in the efficiency of cast-iron and steel pulleys have been confirmed by the tests run by Profs. H. Diederichs of Cornell University and C. H. Perkins of the Lowell Textile School.

Prof. Will Miller Sawdon, M.E., of Cornell University, in a series of tests that he ran, found: "That for slips of from 1 to 2 per cent. the plain cast-iron pulley has the lowest value of coefficient of friction." In speaking of a graphic chart prepared from the test which he made on wood pulleys he said: "The curve of the wood pulleys shows that up to one-half of 1 per cent. slip it has a high coefficient of friction, after which the slip increases rapidly, and beyond 3 per cent. the coefficient of friction is less than for cast iron."

But how does the belt slip affect the cost of power or the amount of fuel that is required in a plant? Take a machine, for instance, that requires 15 hp. to operate

it. Let us see what the loss of power would be if the various pulleys on the main shaft, countershaft and machine were of cast iron instead of steel. As there is a loss of power due to belt slip at each pulley, it will be clearer how this loss occurs if it is traced from pulley to pulley.

Let the diagram, Fig. 1, illustrate a layout of a machine driven from a countershaft, which in turn receives its power from the main shaft. Pulley No. 1 in the illustration is the driving pulley on the machine;

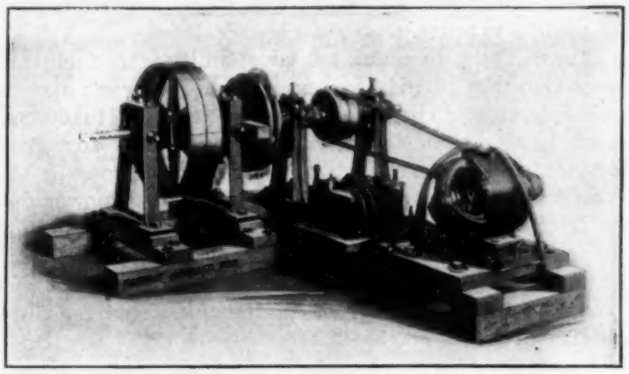


FIG. 2. DYNAMOMETER FOR TESTING AIR RESISTANCE OF PULLEY ARMS

pulley No. 2 is the countershaft pulley, which is belted to pulley No. 1; pulley No. 3 is the countershaft pulley that is belted to pulley No. 4 on the main shaft; pulley No. 5 is the main-drive pulley on the main shaft.

Assuming that the belt slip of a cast-iron pulley is 4 per cent. (actually it is more than this), then pulley No. 1 on the machine will lose, due to belt slip, 4 per cent. of the power delivered to it; in other words it will transmit only 96 per cent. of the power delivered to it.

To find what power must be delivered by pulley No. 2 on the countershaft to pulley No. 1, in order that the machine should receive 15 hp. divide 15 by 96 per cent., thus:

$$\frac{15}{.96} = 15.625 \ hp.$$

Pulley No. 2 is also only 96 per cent. efficient, so that if it is to deliver to pulley No. 1 15.625 hp. it must have delivered to it by pulley No. 3:

$$\frac{15.625}{.96} = 16.276 \ hp.$$

For pulley No. 3 to deliver 16.276 hp. it must have delivered to it by pulley No. 4 in order to make up for its belt slip:

$$\frac{16.276}{.96} = 16.954 \ hp.$$

In the same way pulley No. 5 must deliver to pulley No. 4:

$$\frac{16.954}{.96} = 17.660 \ hp.$$

And finally the motor must deliver to pulley No. 5:

$$\frac{17.660}{.96} = 18.396 \ hp.$$

In other words 18.396 hp. must be delivered by the motor to the main drive pulley in order to take care of the loss in transmission and still deliver 15 hp. to the machine.

This loss of 3.396 hp., due to the belt slip of cast-iron pulleys, is 22.6 per cent. of the power required at the machine.

As the belt slip of a steel pulley has been shown by tests to be less than half that of a cast-iron pulley, by using the former there might be a saving in the above case of 1.83 hp.

Figuring the cost of power at $40 horsepower a year—and this is at present a very low figure—it costs $73.20 a year extra to furnish power to such a machine by means of cast-iron pulleys instead of steel pulleys. This is an increase of over 11 per cent. in the cost of power, due to the greater belt slip of cast-iron pulleys.

If there were 100 similar machines in a plant this saving in the cost of power would amount to $7320—something worth considering, and each additional transmission entails additional loss.

Looking at it in another way, and assuming that it required 3 lb. of coal to generate 1 hp. per hour, then

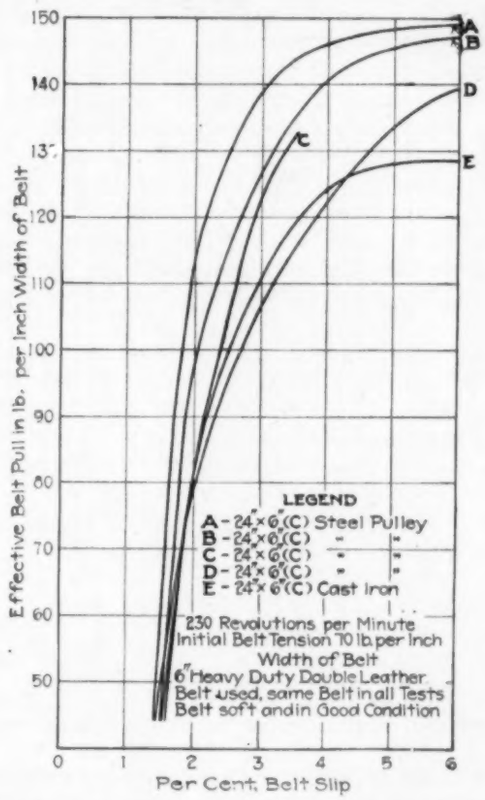


FIG. 3. CURVES FROM TEST OF ONE CAST-IRON AND FOUR STEEL PULLEYS FOR BELT SLIP

the steel pulleys will save 1.83 hp. $\times$ 3 lb. of coal $\times$ 10 hours = 54.9 lb. of coal per day per machine, or $\frac{54.9 \times 300 \text{ days}}{2000} = 8.23$ tons of coal per machine per year.

In the case of 100 machines of this kind in a plant steel pulleys would effect a saving of 823 tons of coal a year.

As the loss of power or fuel at any pulley is proportionate to the amount of power transmitted by that pulley it stands to reason that the main-drive pulley is the point at which more power is wasted through belt slip than at any other pulley in a plant. If a main-drive pulley transmits say 500 hp. and is made

of cast iron, approximately 4 per cent. of the power will be lost through belt slip, or 20 hp. This would mean a waste of fuel each year at this one pulley of 20 horsepower.

$$\frac{20\ hp. \times 3\ lb.\ of\ coal \times 10\ hr. \times 300\ days}{2000} = 90\ tons$$

A steel pulley in such a position and operating under the same conditions would save half of this loss, or 45 tons of coal a year.

For the main-drive pulleys, and in fact for motor pulleys, loom-spinning and twisting-frame pulleys or any pulley where a minimum of belt slip is essential, steel pulleys with cork inserts set in the face of the pulley should be used, for the steel pulley with cork inserts is as superior to the pulley with plain rim, as far as belt slip is concerned, as the latter is superior to a cast-iron pulley.

Prof. C. H. Perkins of the Lowell Textile School, in a series of tests that he ran with steel pulleys 18 x 6 in., with and without cork inserts, found that the

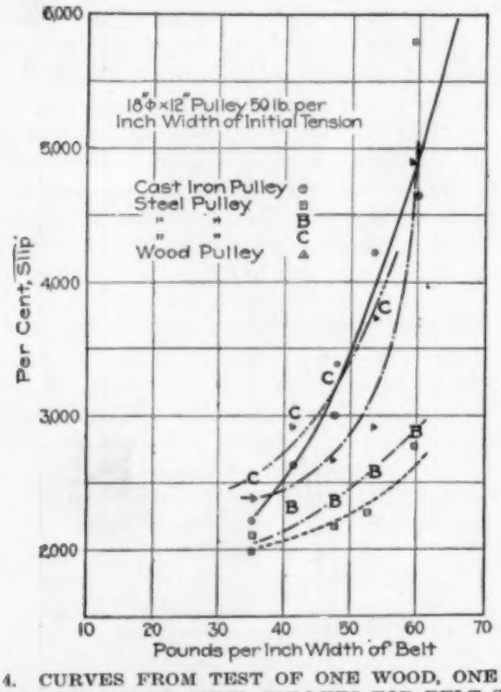


FIG. 4. CURVES FROM TEST OF ONE WOOD, ONE CAST-IRON AND THREE STEEL PULLEYS FOR BELT SLIP

plain-rimmed transmitted 8.3 hp. with a 2-per-cent. slip, while the one with cork inserts transmitted 13.2 hp. with a 2-per-cent. slip when tested under the same conditions. This showed a gain in efficiency of the steel pulley with cork inserts of 60 per cent. over the plain rim. These tests showed that a steel pulley with cork inserts will transmit a given amount of power with less belt slip than one with a plain rim, or it will transmit the same amount of power with the same belt slip, but with less belt tension, thus lengthening the life of the belt.

While the greatest losses in power transmission are due to the slipping of belts on the pulleys there are other losses that can be avoided through the use of a well-designed pulley, because it has been found that difference in the design of the arms will have an important effect on the air resistance and therefore the power required to rotate a pulley without a load.

The American Pulley Co. has designed a very accurate dynamometer, Fig. 2, for testing the air resistance of pulleys, and has obtained some interesting figures in the tests that it has conducted for air fanning on different types and makes of belt pulleys.

In some cases the difference in the cost of rotating a steel pulley, the arms of which are designed to cut the air, as compared to the cost of rotating a steel pulley, the arms of which fanned the air, was as much as $1.30 per pulley per year. With a large number of pulleys in a plant this might well be an important item of useless expense.

These facts indicate an opportunity for fuel conservation that should have every manufacturer's serious consideration. The steel pulley is from 40 to 60 per cent. lighter than cast-iron pulleys designed for equal service, and this means a reduced friction loss in the bearings and the hangers. While the loss of power due to friction in the bearings is one well worthy of study, it should be understood that the principal loss in the transmission of power by belts and pulleys is that due to belt slip, and therefore is the one requiring first attention.

When considering changes in the transmission system in any plant to increase its efficiency the fact that steel pulleys are always split is of importance, as it allows them to be put in place, without taking down and dismantling a shaft during the noon hour, thus avoiding a shutdown of the plant.

The American Pulley Co. maintains at its works in Philadelphia a completely equipped laboratory for making tests of belt pulleys for belt slip, air resistance and overloads. It offers all of its facilities for testing to any engineer of a plant or consulting engineer who wishes to avail himself of them to make tests in person or to confirm the results of the tests here mentioned.

Drop-Forge Wrench Conservation

At a meeting of the drop-forge wrench manufacturers held at Buffalo, N. Y., on Aug. 7, 1918, material reductions in the sizes, styles and finishes of drop-forged wrenches were agreed upon to further the Government's conservation policy. It was decided to discontinue the manufacture of regular finished wrenches, which will release a great deal of polishing and lacquering labor, and it was also agreed upon to discontinue the manufacture of the so-called heavy capscrew wrenches, including all millings from these blanks; 22½-deg. angle or textile wrenches, including all millings from that line of blanks; concave S wrenches; long flat-handled wrenches; double-head socket wrenches and miscellaneous wrenches.

The lines of wrenches retained as necessary are engineers', check-nut, light capscrew, hexagon box, square box, flat-handled S, setscrew, toolpost, single-head socket, spanner, construction, structural, round-handled track, car, and light service, all of which are so useful as to make their elimination doubtful from the viewpoint of conservation.

Until the exhaustion of the present stock all orders received for regular finished wrenches or for any of the above lines will be filled as specified. Thereafter, for discontinued lines there will be supplied wrenches of the nearest designs.

War Sparks from Industry's Forge

Edited by E. C. Porter

During August merchant ships built in the United States and officially numbered, including also those built for foreign owners, aggregated 295,849 gross tons. For the 12-month period ended Aug. 31, 1918, the total output was 1,787,730 gross tons. Before the European war our largest output was 614,216 gross tons for the fiscal year ended June 30, 1908.

* * *

The imports of typewriters and parts into Japan have increased from a value of $25,927 for 1915 and $70,663 for 1916 to $126,796 for 1917, and practically all were imported from the United States. Consul Robert Frazer of Kobe reports that Japan is enjoying an enormous expansion of foreign trade and the necessity of using typewriters in their foreign correspondence has become apparent to most of the Japanese trading firms.

* * *

One thousand Victoria Crosses have been awarded since the decoration was instituted by Queen Victoria at the time of the Indian Mutiny when 182 crosses were awarded. In the Crimean War 111 were won; in the South African War 78; in the Zulu war 23, and in the Afghan War 16. Nearly 200 were awarded in the present war up to September, 1916, and the thousandth on the roll was obtained by Driver Dalziel, an Australian.

* * *

The speed ship "Tuckahoe," which was built in the record-breaking time of 37 calendar days, continues to make phenomenal time in the important coal-carrying trade between Hampton Roads and New England. The "Tuckahoe" has set for other colliers in this trade a pace of four round trips a month. The average has been two round trips a month. On her last trip to Boston, she went in and out of port, discharging nearly 5000 tons of coal in 31 hours.

* * *

The War Industries Board and the Bureau of Standards have joined in recommending for the duration of the war certain detailed standards covering construction and operation of a number of classes of appliances used in fire protection and fire prevention, including hose, hydrants and similar extinguishing agents, fire doors and similar fire retardants, and electrical fittings of all classes which need standardization from the point of view of fire hazard. To facilitate uniformity in procedure on all matters relating to the subject A. O. Boniface has been designated as the coöperating agent between the Fire Prevention Section of the War Industries Board and the United States Bureau of Standards.

* * *

A representative of the United States Employment Service of the Department of Labor and an expert in industrial management are making an investigation in one of the largest war plants in the country with a view to helping to reduce labor turnover, which has been very large of late. This plant, the officials of which are working with the Employment Service and have invited it to make the investigation, is now calling for 2000 unskilled workers a week, owing to the constant fluctuation among the men. By remedying the conditions which cause this instability of the unskilled working force a part of the men now estimated to be needed can be used to supply other important and short-handed war industries.

* * *

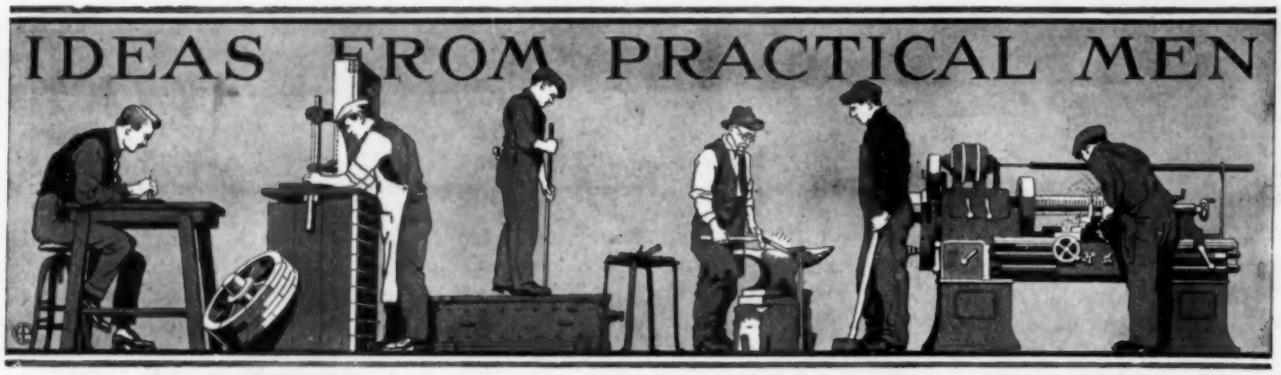
Twenty-two officers and civilians formerly handling fuel matters for the Ordnance Department and located in various production districts have been transferred to the Quartermaster Corps and have been assigned under the direction of the Fuel and Forage Division of the corps to the offices of the State Fuel Administrators in New England and the states east of the Mississippi River. They will be located in the State Fuel Administrators' offices, and their duties will be to assist all War Department contractors in securing their fuel requirements. They will also be of service generally to all coal consumers who are supplying equipment or material to the War Department.

* * *

Every private factory in the United States devoting more than 50 per cent. of its total output to ordnance material is to have the privilege of flying a specially designed flag. Orders to this effect have been issued by Maj. Gen. C. C. Williams, U. S. A., and managers of the various ordnance production districts have been requested to inform the Ordnance Department at Washington of the number of plants affected. The flag measures 4 x 6 ft. Around the four sides is a red border. Within this border are three broad panels, the center one blue and the outer ones white. In the middle of the center panel of blue there is a design in white of a bursting bomb, the insignia of the ordnance service.

* * *

The Ordnance Department has issued a statement to the effect that chemically treated cotton cloth as a substitute for silk is undergoing tests at the Aberdeen Proving Grounds. Silk is used by the Ordnance Department by the hundreds of thousands of yards for making the bags containing the powder that furnishes the propelling charge for the projectiles in the big guns. A short time ago a textile firm brought to the attention of the Ordnance Department a substitute consisting of a cotton cloth treated with a chemical solution, and tests made at the proving grounds justified proceeding further with the experiments. For this purpose an order of 5000 yd. of the new material has been placed with the firm responsible for its discovery. It is estimated that the cloth now undergoing test, if it proves entirely suitable, can be secured in practically unlimited quantities and at an estimated saving in the ordnance program of between $25,000,000 and $35,000,000.



Repairing a Broken Crankshaft

By C. R. Courtenay

We were recently called upon to repair the crankshaft of a 10 x 20-in. steam engine which operated the pulp grinders at the local paper mills, it being important that the repair should be made in the shortest possible time as the mill depended upon this power unit for its supply of ground wood. A new forging could not be obtained in less than three weeks, and as this delay was out of the question our only resort was to weld the broken shaft.

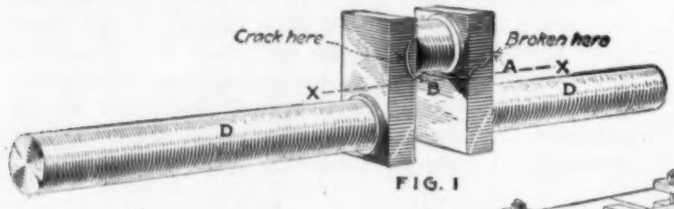


FIG. 1

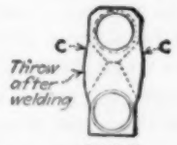


FIG. 2

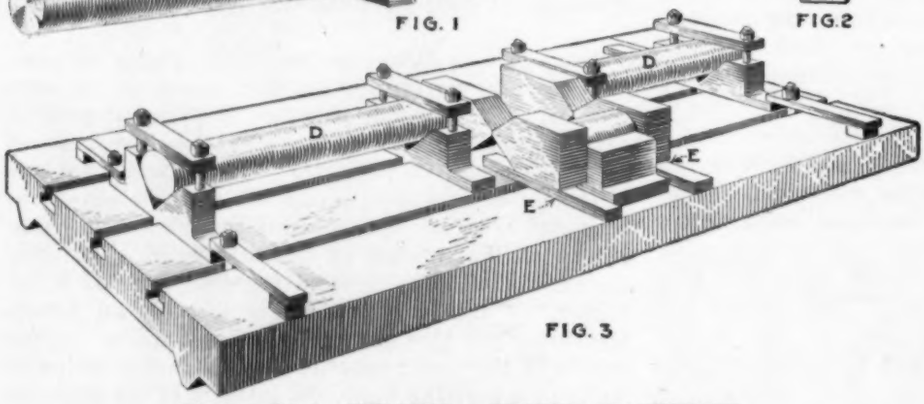


FIG. 3

FIGS. 1 TO 3. WELDING A BROKEN CRANKSHAFT
Fig. 1—The broken shaft. Fig. 2—Appearance after welding. Fig. 3—The set-up

The shaft was broken at *A* and partially broken at *B*, as shown in Fig. 1. We had an oxyacetylene welding outfit, and our first idea was to weld the shaft as it was, which could have been done at *A*, but the break at *B* was so located that it was impracticable to scarf off the sides to secure a sufficient bonding surface for the weld. We decided to cut the pin from the webs as at *X* and substitute a new one, and in order to save the time necessary for turning the new pin after it had been welded in place we decided to finish it complete beforehand. This meant that the pin must be held firmly in perfect alignment with the main parts of the shaft during the welding process.

To do this we made four V-blocks with projecting lugs to match the groove in our planing machine, and another block of the same dimensions without the lug

As an extra precaution we turned the new pin $\frac{1}{16}$ in. oversize with the idea that we would have enough stock for re-turning in case anything happened to move the parts out of alignment during the welding process. At the same time we calculated that if the parts did come square it would only be necessary to rebore the crankpin box to fit the oversize pin, which would be a small job compared with re-turning the pin.

After the webs were cut off each was scarfed at an angle as indicated by the dotted lines at *C* and *C*, Fig. 2. The whole was then assembled on the planing-machine bed, Fig. 3, *D* being fastened first; then the new pin was placed in its V-block and carefully lined up with the main parts of the shaft.

Two finished strips *E* were then bolted to the bed to form a guide for the V-block holding the new pin, as it was thought that this block would have a tendency to move when heat was applied. To take care of this expansion the distance from center to center was made about $\frac{1}{16}$ in. less than the required throw.

In Fig. 3 some of the straps are omitted for the sake of clearness. Asbestos paper and firebrick were placed underneath and around the pin and webs in order to protect the planing-machine table from the heat.

The welding was now started, heat being applied first to one side and then to the other with the idea of heating the webs uniformly. The building-up process was carried out in the same manner by alternating the torch from one web to the other to avoid distortion as much as possible and thus make it unnecessary to remachine the pin and possibly the whole shaft. After one side of both webs was welded the whole was turned over and the process repeated upon the other side. During the welding process the bolts holding the pin were eased off slightly in order to allow the block to move outward in the guides.

After the weld was completed and the shaft had cooled sufficiently it was put upon centers, tested for accuracy and found to be correct in every way. The engine has

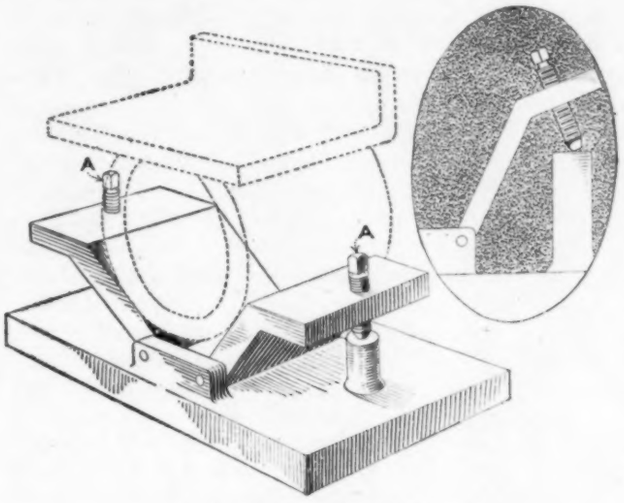
now been running approximately 60 days since the repair and is giving complete satisfaction.

It will be noticed in Fig. 2 that the new portion of the web was made wider than the original and resulted in a much stronger web, the middle section being built out to 7 in. instead of 5 as in the original.

An Adjustable V-Block

By F. M. Vandervoort

The illustration shows an adjustable V-block I am using for milling the surface of the casting shown in place in the sketch. The best means of locating the



ADJUSTABLE V-BLOCK

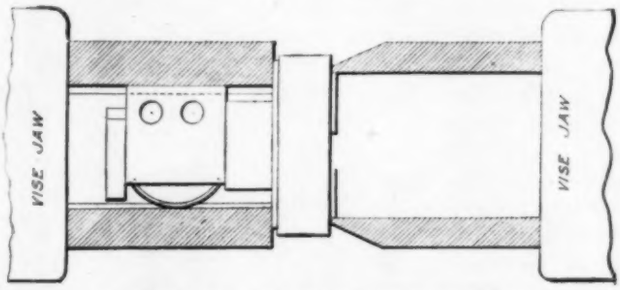
work seemed to be by a V-block; a solid one was tried, but gave trouble on account of excessive variation in the diameter of the boss on the castings, so I conceived the idea of making it adjustable, as shown, to compensate for variations. Adjustment is by means of setscrews *A*.

Enlarging a Small Brass Piston

By J. K. Long

A device to enlarge the pistons of feed valves by the use of which a very considerable saving is effected is shown in the drawing.

Formerly when the pistons became worn too small for the successful operation of the feed valve they



METHOD OF ENLARGING THE PISTON

were thrown away and new ones applied, which, taking into consideration the thousands that are in use, constituted an excessive waste.

In this device two bushings are made of axle steel, one of which has a flat spot $\frac{5}{8}$ in. wide cut through the hole, and into this the slide-valve face is placed, the piston coming against the end of the bushing.

The other bushing has a $1\frac{13}{32}$-in. hole. It is 2 in. outside diameter, and at a point $\frac{1}{2}$ in. from the end it tapers down to $1\frac{7}{32}$ in. which leaves a wall thickness of $\frac{1}{16}$ in. at that end.

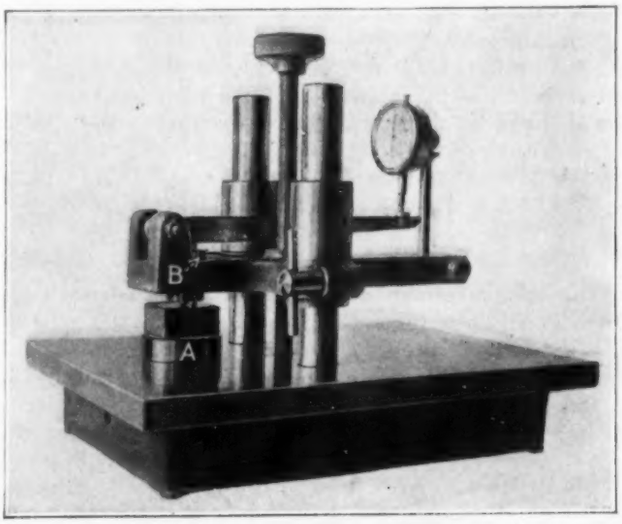
In use it is placed in the vise as shown, and a slight pressure with the vise screw forces the tapered end of the bushing into the piston, enlarging it slightly. This can be done repeatedly, each time marking the piston to show how many times the operation has been performed, as it is not desirable more than five times.

An Amplifying Gage

By A. A. Case

To assist in the rapid inspection of pieces made by students taking a course in machine work at the Ohio State University an amplifying gage has been devised by the instructors and built by students who are taking advanced work. As may be seen the principle is an old one. A lever having a ratio of 10 to 1 is employed, so that if the gaging point be raised 0.0001 in. the indicating end will be raised 0.001 in. A dial indicator is attached to the long end of the arm and its readings thus become 0.0001 in.

All moving parts are hardened and ground or lapped as nearly as possible. The base is of heavy surface-plate construction reinforced by ribs to absorb all vibration. *A* is a piece of hardened steel ground true



ACCURATE-GAGING INSTRUMENT

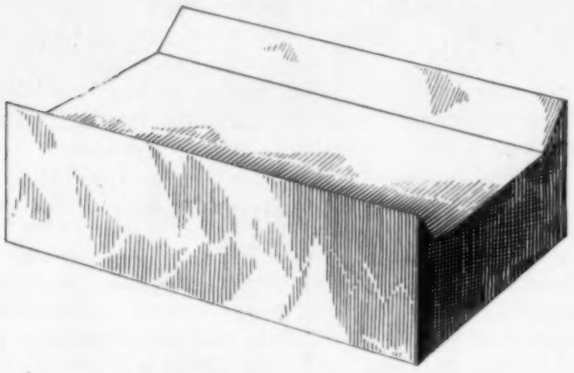
and parallel which serves as an anvil on which the piece to be tested is placed. Adjustment is provided at *B* to bring the dial reading to zero, this first reading being obtained by a standard test block. With this instrument a number of pieces can be rapidly checked showing variation correctly to 0.0001 in.

We find this gage to be of material assistance to the student in making duplicate pieces, and while it seems very difficult for a beginner to judge the amount of pressure on the micrometer screw when taking readings to 0.0001 in., with this instrument the personal equation is practically eliminated.

Steel Insert in Cast Iron

By Alfred E. Carter

It is sometimes desirable to set a piece of tool steel in the face of a casting as a bearing spot for a setscrew or where some reciprocating part would cause undue wear of the casting. The method shown in the



STEEL INSERT IN CAST IRON

sketch is a neat way of doing this, making the use of screws unnecessary, and if done in a proper manner it will be impossible for it to loosen or be removed.

The patch should be made first and used to mark out the hole in the casting. The hole should be milled or drilled and chipped out neatly to a good fit around the edges and about $\frac{1}{64}$ in. less in depth than the thickness of the patch to allow for surfacing. The patch is then driven in with a heavy hammer or forced in with a press and the surface smoothed with a file.

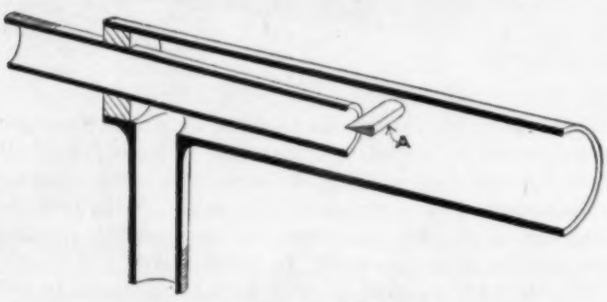
The dimensions will of course vary to suit the job, but the projections should always be on the longest side of the piece. The sketch shows the piece exaggerated for the sake of clearness. The projections will expand at the bottom of the hole, making a positive lock.

An Improved Gas Burner

By E. O. Gilson

The sketch here shown is that of a gas burner that I designed when for a considerable period last winter the natural-gas pressure was too low to furnish the required degree of heat for our brazing operations.

Burners which were purchased with a view to relieving the difficulty did not give satisfactory results



IMPROVED GAS BURNER

in this respect and were a further source of trouble owing to their causing rapid deterioration of the crucibles used in connection with the operation. With the last-mentioned burners a crucible burned out in two days, while with our own design one would last from seven to seven and one-half days.

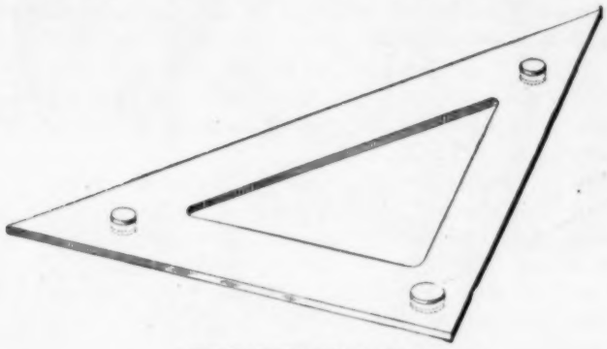
The principle of the burner is very simple, the special feature consisting of a wedge *A* welded across the opening of the air tube, spreading the blast and causing a partial vacuum which draws in the gas and compensates for loss of pressure. With suitable valves on the air and gas lines the flame may be regulated to suit the work.

Improved Triangle for Draftsmen

By F. J. Burridge

Here is a little kink applied to a draftsman's triangle rendering it easier to hold in position, and crippled men, dependent upon an artificial hand for this work, will find it worth while.

Bore and tap a small hole near each angle, as shown



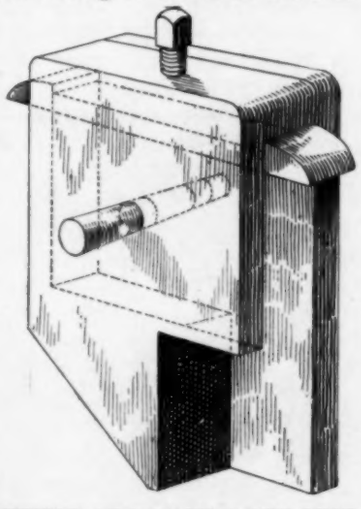
IMPROVED TRIANGLE

in the sketch, and screw in rubber pencil erasers, trimming them down with a sharp knife, leaving about $\frac{1}{64}$ in. protruding from each side.

Locating Gage Stops on Shearing Dies

By George M. Piper

I have experienced considerable trouble and loss by reason of the gages on shearing and punching dies slipping, and after experimenting to overcome the difficulty I have adopted the method shown in the drawing for locating all stop gages. For all regularly specified lengths the stop is held positively by means of the taper pin passing through the stop and bar. The little key in the back does away with the marring of the gage bar by the cupped point of the setscrew, which marring would make it difficult to secure an accurate setting when it was necessary to move the stop $\frac{1}{32}$ in. or so. This little improvement has worked well for us and I trust is worth passing along.

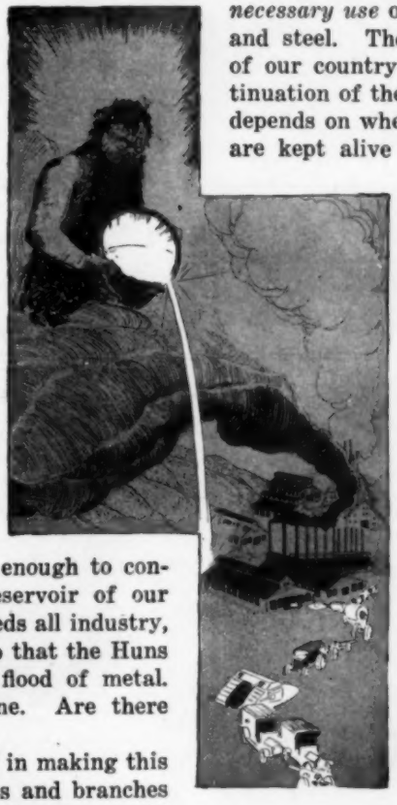


METHOD OF LOCATING THE STOP

Feeding Our Industrial War Goats

WHEN the War Industries Board announced the classification of essential industries into four priority divisions, figuratively speaking and from a strictly war standpoint, it separated the industrial sheep from the goats.

First the sheep will be fed with labor, material and transportation, and then whatever remains will be available for the goats. Now this is good, sound war policy, for we must have the wool from these essential sheep in order to win the war. But it does not license any particular sheep to make a hog of itself and waste nourishment.



Our tremendous war program requires an almost unimaginable amount of iron and steel. Picture to yourself the flood of these metals now pouring into our new ships, these ships in turn carrying to France without interruption railway equipment, locomotives and motor trucks, Liberty motors and tanks, guns and howitzers. Picture to yourself rivers of metal flowing into our munition factories for the making of thousands upon thousands of guns and millions upon millions of shells. No human imagination is big enough to conceive this thing as a whole. The reservoir of our metal resources, which in peace time feeds all industry, is now being discharged into France, so that the Huns may be deluged under an irresistible flood of metal. Your plant is a part of the pipe line. Are there any leaks in your section?

The criterion of essentialness applied in making this arbitrary distinction between industries and branches of industries is strictly based on win-the-war needs. Many a nonessential-to-war industry is highly essential to a well-balanced national peace-time industrialism.

The majority of you who will read this editorial are in the preferred classifications. You are of the machine-tool-creating or machine-tool-using category, and hence a vital factor in the winning of the war. You will get your steel, coal and railway cars. Your plant has been selected and your neighbor's plant has been rejected not because yours is more vital to normal national welfare, but solely for the fact that yours plays a more immediate part in this war emergency.

This places a heavy burden of responsibility upon you. Your moral obligation to conserve material has increased a hundredfold through this very selection. The man who gets the first place at an insufficiently supplied table must eat sparingly.

The fact that *your* industry is declared essential should redouble your efforts toward economy in the use of what this preference gives you.

The level in our metal reservoir cannot be maintained by simply diverting materials from the nonessential to the essential shops. It can be maintained only if everyone of you who are essential is constantly on the watch to prevent not only the waste but the *unnecessary use* of our present-day precious metals, iron and steel. The well-balanced industrial development of our country after the war, which means the continuation of the peace-time markets for your products, depends on whether our nonessential-to-war industries are kept alive or starved to death. And this rests entirely on you. Start a material-conservation department in your plant. Put a good man in charge of it and pay him for what he saves.

Don't dismiss this matter by saying that you are down to the limit now. It proves you haven't any imagination. All limits are movable.

Your patriotism can be measured by the inverse ratio of your scrap pile to your manufactured product. A soldier who wastes ammunition is not more negligent than a manufacturer who wastes essential material.

Make the foundation come up to meet the machinery—don't let the machinery extend down beneath the foundation. Make a careful study of the uses of concrete and wood. When necessary the boys "over there" improvise wooden gun mounts and get away with it.

Don't try to maintain during war time the reputation of excessive strength which comes through prodigality of metal in your product. It spells "quality" in peace time but "calamity" in war time. Save a few pounds here and there for the sake of the nonessential classes.

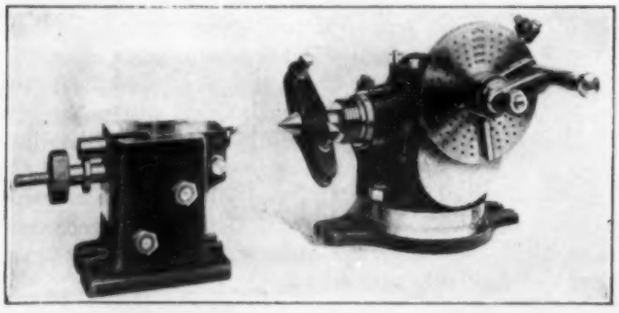
When you take your place at the table remember our industrial war goats. Save the crumbs!

John H. Van Deventer

This department is open to all new equipment of interest to shop owners. Photographs and data should be addressed to Editorial Department, "American Machinist"

Schipper Universal Index Centers

C. F. Kern, 26 Hulbert Block Cincinnati, Ohio, is now manufacturing the universal index centers shown in the illustration. The head is universal and can be set at any angle from 10 deg. below the horizontal to 10 deg. beyond perpendicular. It can also be rotated on the base to any angle desired. The swing on the



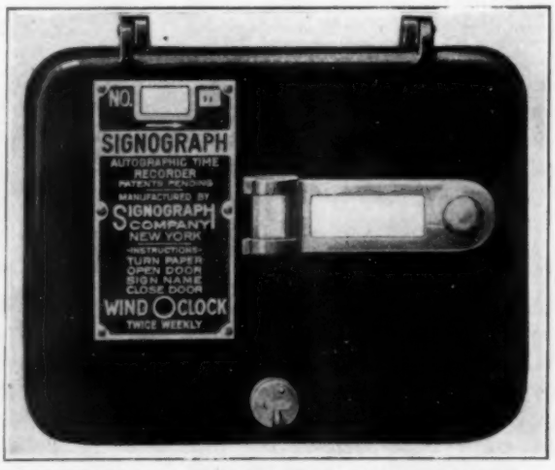
SCHIPPER UNIVERSAL INDEX CENTERS

Swing on centers, 10½ in.; index plates divide from 2 to 400 inclusive; weight, boxed, 105 lb.

centers is 10½ in. and the index plates divide all numbers from 2 to 400 inclusive. The spindle is provided with an adjustable taper bearing at the rear end, and the clamp ring relieves the worm and wormwheel and index head from all stress during the cutting operation. Provision is made for taking up wear in the worm and wormwheels. Both head and tail ends are fitted with ⅝-in. tongues to fit the standard slot in milling-machine tables, but special tongues can be furnished if desired. Four T-bolts and two wrenches are furnished with each pair of centers.

Sinograph Time Recorder

The Sinograph Co., Inc., 412 Eighth Ave., New York City, is now marketing an autographic-recording device invented by H. Hartman. This device is suitable for shops or offices, or where the number of persons for each recorder does not exceed 50. The device measures 9 x 7 x 3¼ in. and the person registering signs his name through the small writing window shown at the front, which is nominally closed by a metallic frame containing a celluloid window which shows the name of the last person signing. The paper is moved by turning the knob at the side. The mechanism consists mainly of an eight-day-clock movement, a metallic printing dial 4½ in. in diameter driven by the clock and making a full revolution in 24 hours. The hours are engraved on this dial facing toward the paper which passes from one roller to another over a portion of the dial, hours during the day being in Arabic numerals, while those during the night are in Roman. The dial is so arranged that it changes the day of the week at midnight. No ink ribbon is used, the time and day being embossed into the paper when the small door is opened, while a pin projecting from the die



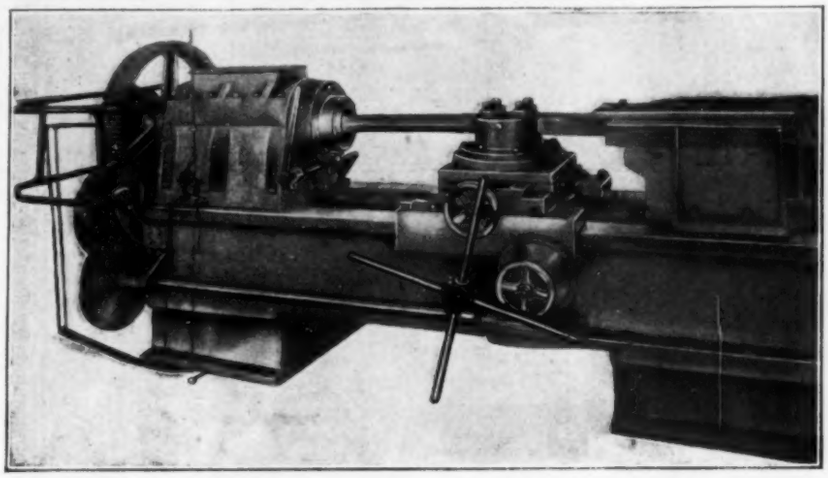
"SINOGRAPH" AUTOGRAPHIC TIME RECORDER

pierces the paper to show the time of registering. All parts except the clock, the Yale lock and the printing wheels are made of die castings. One record roll is of sufficient size for 500 signatures and the clock can be wound from the outside without unlocking.

"Galloway" Shell-Boring Lathe

The A. R. Williams Machinery and Supply Corporation, Fidelity Building, Buffalo, N. Y., is now marketing the "Galloway" shell-boring lathe shown in the illustration, the machine being especially adapted for boring 155-mm. and 6-in. shells. The bed is of cast iron provided with cross-ribs and has a heavy headstock bolted in place. The spindle will take shells up to 6 in. in diameter and draw-in collet equipment is included with the machine. The bearings are of phosphorous bronze. Flat-ways are provided for the carriage, and these are

said to be extra long, while the bridge is of such proportions as to insure a solid base for the toolpost which pivots on the carriage by means of a taper ring, clamping the toolpost to the carriage and allowing for taking up any lost motion centrally. The tailstock is designed to carry the profile plate. A square steel boring bar is used, this being rounded only on that part entering the shell. The machine has been especially constructed for single-point rough-boring long taper in projectiles.



GALLOWAY SHELL-BORING LATHE

Swing over bed, 30 in.; width of bed over ways, 32 in.; depth of bed, 18 in.; length of bed, 10 ft.; length of carriage, 30 in.; width of bridge, 20¾ in.; length of profile slide, 32½ in.; greatest distance between face of spindle and tailstock, 4 ft. 4 in.; diameter of drive pulley, 22 in.; width of belt, 6 in.; size of tool bar, 4 x 4 in.; width over ways, 7 in.; floor space required, 3 ft. 6 in. by 12 ft. 6 in.; approximate weight, 14,000 lb.; rear spindle bearing, 6 x 15 in.; front spindle bearing, 11 x 15 in.; internal bore of spindle, 7 x 22½ in.; length of main spindle, 48¾ in.; hole through spindle, 2⅜ in.; diameter of drive gear, 35 in.; gear ratio, 6 to 1; speed of drive pulleys, 110 r.p.m.

Alternating-Current Arc-Welding Apparatus

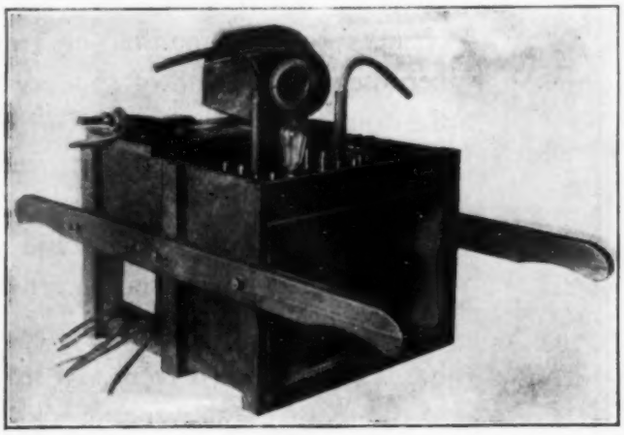
The Electric Arc Cutting and Welding Co., 222 Halsey St., Newark, N. J., is now marketing the alternating-current arc-welding machine shown in the illustration.

This illustration shows the entire apparatus for use on a single-phase circuit, the current being brought in through the wires seen protruding at the lower left corner. It is claimed that this apparatus obviates the use of a motor-generator set, switchboard and other apparatus customarily used with direct current.

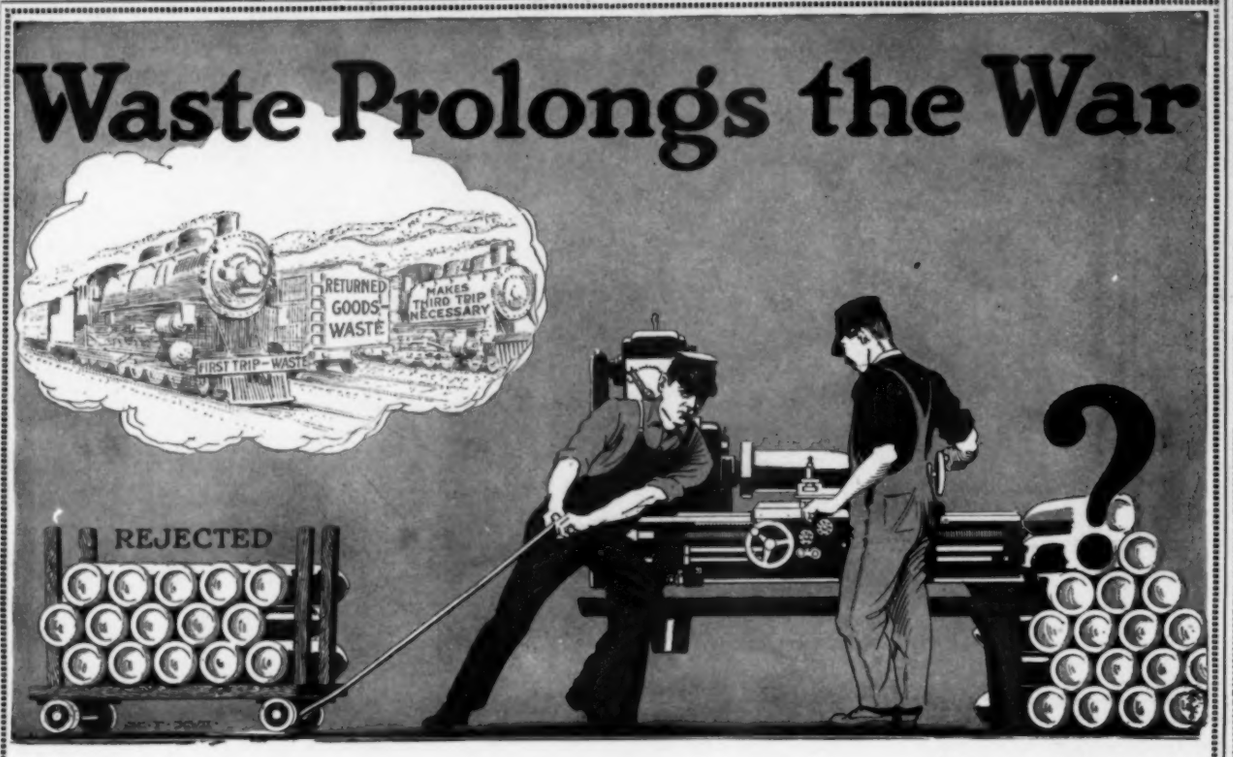
The device consists principally of a transformer with no moving parts and is claimed to last indefinitely. In this apparatus, instead of holding either current or voltage constant as with direct-current sets, the wattage, or the product of voltage and current, is held constant. The alternating-current machine holds the arc wattage without moving parts; hence the heat is substantially constant for any given setting, and it is claimed that as soon as any person becomes accustomed to the sound and sight of the arc and can deposit the molten metal where he desires it is impossible to burn the metal from too much heat or make cold-shot welds from too little heat. The amount of heat generated is controlled by means of an adjusting handle on the transformer together with taps arranged on a plugging board. The efficiency is said to be from 80 to 90 per cent. of the power input. It is stated that the kilowatt-hours required to deposit a pound of mild steel with this machine varies from 1½ to 2¼.

The largest alternating-current machine made is of the 60-cycle type and weighs about 200 lb., which places it in the portable class. The machine can be furnished for any alternating-current power supply, but it is not advisable to use a greater voltage than 650 on the primary. The machine can also be made single phase, two phase three wire, two phase four wire, to operate across the outside wires of the two-phase system or from a three-phase power supply. Polyphase machines are about 30 per cent. heavier than the single-phase machines. In the two-phase machine absolutely balanced current can be drawn from each of the two phases by placing the machines across the outside wires. This is advocated, as it provides for leading current on one phase which brings up the total power factor of the system and a better power rate can be obtained. In polyphase circuits where more than one machine is used single-phase machines can be distributed among the several phases.

Among the advantages claimed over direct-current welding apparatus are the reduction in cost of necessary wiring and the low maintenance due to the absolute doing away with moving parts. It is also claimed that this machine has greater penetrative qualities than direct-current machines and that the difficulties that have previously been experienced in welding cast iron are overcome. It is also claimed that the metal deposited has a smoother surface than is obtained with direct-current arcs. Another feature claimed is that electrolytic corrosion is done away with. The machine can be made especially for welding and for cutting or for combination welding and cutting and can make use of bare wire, slag-covered, gaseous fluxed or carbon electrodes. An operator's mask and the welding handle used may be seen on top of the complete apparatus shown in the illustration.



COMPLETE ALTERNATING-CURRENT ARC-WELDING APPARATUS



WASTED material and spoiled work prolong the war. Not only do they delay the production of the work spoiled, but they affect all other supplies as well.

Every pound of metal wasted, every pound of spoiled product clogs the whole productive machinery of the country. Such mischances spell congestion of transportation, already overstrained, because every pound of spoiled work must go back to the mills or the foundry to be remelted or remade and new materials sent in place of what has been destroyed. This rehandling requires labor which might be employed on new stock. It requires more coal, which means more mining, and yet again more transportation, and both coal and transportation are of vital importance at this time.

Spoiled work not only requires rehandling, but all the labor which has been put into it from raw to finish must be repeated. The wear of the tools, the power required—which in itself gets back again to the coal mines and to transportation—have all been wasted. Not only is the world the poorer, but it all helps to prolong the war.

LATEST ADVICES FROM OUR WASHINGTON EDITOR

Washington, D. C., Sept. 14, 1918—As mentioned some time ago the Screw Thread Commission appointed by Congress consists of nine members. They have now been appointed, and they can be given work at any time. S. W. Stratton, Director of the Bureau of Standards, is the chairman. The other nominations follow:

War Department—Lieut. Col. Eugene B. Peck, Ordnance Department, Engineering Division; Major Oliver B. Zimmerman, Corps of Engineers, General Engineering Depot.

Navy Department—Commander E. J. Marquart, Bureau of Ordnance; Commander S. M. Robinson, Bureau of Steam Engineering.

Society of Automotive Engineers—Edwin H. Ehrman, Chicago Screw Co., Chicago, Ill.; H. T. Herr, vice-president of the Westinghouse Electric and Manufacturing Co., Pittsburgh, Penn.

American Society of Mechanical Engineers—James Hartness, president of the Jones & Lamson Machine Co., Springfield, Vt.; Frank O. Wells, president of the Greenfield Tap and Die Corporation, Greenfield, Mass.

These men have been appointed to determine screw-thread standards so that all Army and Navy specifications shall agree in this respect. The unfortunate point of the committee's appointment is that it is limited by Congress to an existence of six months, which is altogether too short to accomplish all that is necessary or desirable in this line. The only hope, now that the committee is appointed, is that it can be continued until its work is done.

The appointment of the members from the two engineering societies should be of considerable assistance in pointing out the work that has already been done along this line to prevent duplication and the establishment of standards that might not work out well in practice in the great branches of the machine-building industry which are entirely apart from the Army and the Navy.

Testing Gages at the Bureau of Standards

It was recently mentioned in these columns that an effort was made by the Inspection Division of the Aircraft Production Board to have the testing of gages for the Ordnance and other departments removed from the Bureau of Standards and turned over to it. The reason given was that the work done by the Gage Testing Department of the Bureau of Standards was not satisfactory in point of time, and that on this account the Aircraft Production Board built up its own testing bureau.

Regardless of whatever defects there might have been in the Gage Testing Department of the bureau it is evident that the proper procedure would have been to improve the work of the bureau, which had been designated by Congress for this purpose and had been given suitable appropriations for the work to be done. Endeavoring to start a new gage-measuring department seems to have little to commend it.

As a matter of fact, however, there appears to be serious doubt as to the justification of the claims of inadequate service from the Gage Testing Department of the Bureau of Standards. The appropriation for this work was passed on June 15, 1917, and the work itself inaugurated 15 days later, or on July 1 of the same year. Since that time there has been a comparatively steady growth of the number of gages tested, the quantity naturally varying from month to month according to the way in which the gages were sent to the Bureau of Standards by the manufacturers.

The first lot of gages was received on July 15, 1917, and it is stated by those in charge that since the beginning of the work the organization and facilities available were always in excess of the demands, this applying both to the equipment and personnel. This indicates that the Bureau of Standards, in this connection at least, has distinguished itself as being one of the few organizations that fully anticipated war needs and had available at an early date an organization to handle promptly and efficiently the urgent demands made during the early stages of the program for securing war supplies.

A Record of the Work Done

Some idea of the amount of work which has been submitted to the Bureau of Standards for tests is shown in the following table:

Date	Number of gages received	Average time of test
1917, July	244	.....
1917, August	473	.....
1917, September	465	.....
1917, October	737	.....
1917, November	1735	.....
1917, December	1142	.....
1918, January	2519	3.9 days
1918, February	1813	5.0 days
1918, March	3582	4.1 days
1918, April	4688	5.2 days
1918, May	4917	5.1 days
1918, June	5559	5.5 days
1918, July	4324	3.5 days

This indicates the number of gages received, tested and certified up to Aug. 1, 1918. About 90 per cent. of these are master gages or precision standards that required special care in testing; the remainder were inspection and working gages. It is also of interest

to note that about 60 per cent. of the above gages were plain gages of the plug, snap and ring variety; about 20 per cent. were profile gages, which include complicated templets, chamber and fixture gages, and that the remaining 20 per cent. were thread gages.

About 60 per cent. of these gages were for the Ordnance Department of the Army, 15 per cent. were for the Motor Transport Division, about 10 per cent. for the Signal Corps, which has now become the Aircraft Production Division, and the remaining 15 per cent. were for other branches of the federal Government and for industrial concerns having Government contracts. This indicates very clearly the comparatively small number of gages tested for aircraft work, and is probably a fair proportion of the number of their gages as compared with those of the Ordnance Department. The figures given in the table do not include gages tested at the branch laboratories in Cleveland, New York and Bridgeport, nor the gages tested by the inspectors of the Bureau of Standards at the various manufacturing concerns.

The time required for testing rarely exceeds three to five days and the tests for the six months of 1917, which are not given in exact figures, average only a little over three days. These figures represent the average time chargeable to the Bureau of Standards after the gages are received. This includes the unpacking, accounting, routeing for tests, testing examination of results of the tests with specifications and drawings, the writing of the report on gages tested and, in case the gages are shipped directly, the time for packing and shipping. This record seems to give a clean bill of health so far as the charges of excessive delays are concerned. But, as before stated, if it is decided that the time taken by the bureau is too long the obvious remedy is to improve conditions there rather than to establish an entirely new department for the same work.

It is interesting to note that the organization of the branch laboratories has been made primarily for the purpose of handling emergency tests for manufacturers of war material rather than for testing gages submitted by the manufacturer. It has developed, however, that many gage manufacturers desire to submit sample gages for test before proceeding with the manufacture of an entire lot of gages, and in this connection the branch laboratories have been of special service to the gage manufacturers and of course to the same degree have aided in the rapid production of munition.

Stick to Your Job

There is an honest doubt in the minds of many good mechanics as to whether they are really doing their duty by remaining in the old shop or whether they should seek occupation in the actual making of munition or similar work. I am frequently in receipt of letters from men of this kind, and while I can thoroughly appreciate their feeling, in nine cases out of ten there seems to be no question as to their being of the greatest service right where they are.

In one case a highly skilled mechanic was at work in a well-known shop engaged in building grinding machinery, and he felt that the Government should have the benefit of his skill in the development of panoramic sights, airplane motors or in other work more directly connected with the war. He had a notion that there would be many advantages in obtaining a commission, and in this he is by no means alone as there have been thousands of similar applications.

In the hope of making it clear to others who have the same desire and the same feeling that they should be engaged upon something more directly connected with the war I am quoting from my letter to him with the idea of pointing out to others what seems to be the most rational course to pursue.

"First of all, may I suggest that you forget the matter of securing a military commission, as these are not being granted nearly so readily as before.

"Your experience evidently makes you most valuable in connection with production either of munition or of some of the various kinds of machinery that are necessary for the manufacture of guns or other implements of war. You are already engaged in this latter work, and it is my sincere belief that you can do a greater service by remaining where you are than by making a change at this time.

"You are already familiar with your present work, and can do more to secure production in that line than in any other. If you start in on panoramic sights, airplane-motor or other parts that may seem to you to be more directly connected with war work it will take some time for you to become familiar with the new line of work you may select. At the same time someone else will have to be trained on your work, and in the meantime the total output of the country has been considerably reduced.

"When you carefully consider all sides of the question do you not believe that you will be doing a more patriotic service to remain in your present position, regardless of the fact that you would probably prefer something which seemed to be more closely connected with war work? Many a soldier would probably prefer being in the front line to driving an ammunition motor truck. But he may be even more important on the truck than in the fighting line, and it is our duty to stick to the job where we can render the greatest service even though we might prefer something else."

New Ruling for Exports to Holland and Denmark

The War Trade Board has announced a new ruling and regulations regarding the exportation of certain commodities to Holland and Denmark. Previous announcements with respect to such commodities have been withdrawn. Applications for licenses to export the following articles will be given consideration: Adding machines; automobiles (passenger), bicycles, motorcycles and separate parts, but no tires and no accessories; cash registers; hardware for builders, if of iron and steel; jewelry (imitation); lighting fixtures, if of iron or steel; cotton-goods machinery, laundry machinery not containing rubber or copper, sugar-refining machinery and spare or replacement parts of machinery; medical and surgical appliances other than those containing rubber; phonographs and phonographic records; sewing machines; scales and balances, not including weights of copper or brass; toys, typewriters and spare parts and accessories, except typewriter ribbons not cut for use, and except ribbons over 2 in. wide.

Manufacturing U. S. Destroyers

Before the outbreak of the war it required two years to build a fast destroyer, but recently one has been built in a little more than two months. These crafts, costing two million dollars, have the engine power of the old battleship "Maine" and the speed of a motor boat and are considered to be the most effective weapon against the German submarine.

When the United States entered the war an attempt was made to build more of this class of ships for the American Navy than had been previously built for any two navies; as a result one was completed in eight months instead of two years and with further speeding up another was completed in six months. In the Mare Island Navy Yard the destroyer "Ward" was launched 17½ days after its keel was laid, and it was completed in 70 days.

The process by which the "Ward" was manufactured is a machine one, by which the United States can produce at the same rate as many destroyers as are needed. The steel parts are prepared in various plants all over the country in accordance with standardized plans. These parts are then assembled in navy yards, put together at the docks, swung into position and riveted in place by a force of men working night and day. In other words, standardized destroyers are being turned out the same as standardized automobiles are turned out, in quantity production. The Navy reports that one flotilla of these destroyers, having steamed a million miles on patrol, has protected 86 convoys and 717 single vessels and fought 81 submarines without any loss to the destroyers or to the vessels which they escorted.

Australian Market for Farm Machinery

The United States is second to Canada in supplying farm machinery to Australia, and its position in the trade is steadily improving. Eleven million dollars' worth of such machinery is required annually by Australian farmers, of which $7,000,000 worth is manufactured at home and $4,000,000 worth imported, according to a bulletin issued by the Bureau of Foreign and Domestic Commerce, Department of Commerce. While the present demand for farm machinery is substantial the Government's report points out that normally Australia is destined to become a much more attractive market for such articles. The increasing efficiency of farm tractors should eventually prove a most important factor in developing the agricultural resources of the country. In spite of the present difficulties in the path of the average American manufacturer the market deserves the utmost attention, especially on the part of those who produce a fair number of the machines most desired by the Australian farmer. The home manufacturers are favored by the fact that much of the land is not cleared of stumps, so that a stump-jump feature is a necessity in most implements. Canadian and American manufacturers have never been obliged to specialize on such a feature, whereas the Australian manufacturer has given it attention for years. This and other disadvantages and advantages are discussed at length in the report for the benefit of manufacturers and exporters who are planning to extend their Australian and New Zealand trade as soon as normal conditions are restored. Conditions governing agriculture are fully described, as are the methods of carrying on the trade in implements and the factors governing the sale of each class of equipment. The report is the work of Commercial Agent Juan Homs and is entitled "Agricultural Implements and Machinery in Australia and New Zealand," Special Agents, Series No. 166. Copies can be obtained at 25c. each from the Superintendent of Documents, Government Printing Office, Washington, D. C., or from any of the district or coöperative offices of the Bureau of Foreign and Domestic Commerce.

Government Enters Educational Field On a Large Scale

The Government has found it necessary to enter the field of education on a large scale. War-emergency courses in employment management, conducted by the Employment Management Division of the War Industries Board, under the auspices of five governmental departments, have been arranged for in nine universities to date. The outline of the courses of study was made by Capt. Boyd Fisher, who has general supervision of the work. These courses are designed to train men or women who already have a basic experience of at least three years in industrial life and factory methods and who have come in actual contact with shop problems. Employers of labor, particularly those having war contracts, are urged to suggest men or women from their own organizations as candidates. The courses of instruction in the various schools run from six weeks to two months, and the classes are conducted by the foremost authorities in the country on the various subjects covered. Employers of labor having candidates for admission and individual applicants will be furnished with necessary information by addressing Capt. Boyd Fisher, 717 13th St. NW., Washington, D. C.

Liberty Is on the Wire

The poster which accompanies this issue may well be called a speaking likeness—calling your attention in unmistakable terms to the vital necessity of getting the Fourth Liberty Loan campaign ready to start at the drop of the hat on Sept. 28.

This poster will be supplied for use in shops and offices on request—it will help get the boys into the bond-buying spirit. "Liberty speaking" is also ready in stickers—as was the previous poster—all ready to help in every possible way.

Liberty is speaking to you—and to us all. Let us get ready to prove that her call will not be in vain.

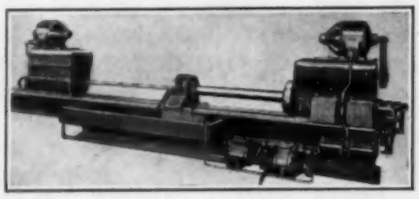
Demand in Chile for Steel Products

According to a report from Punta Arenas, Chile, there is a great demand for steel products. Some of the articles principally in demand and on which no duty is paid are galvanized corrugated iron; tin plate for canning works; smooth, black and galvanized wire; miscellaneous hardware of all kinds; farm implements; machinery and appliances for meat freezing and canning works and for soap factories; sawmill machinery, and butchers' tools.

Condensed-Clipping Index of Equipment

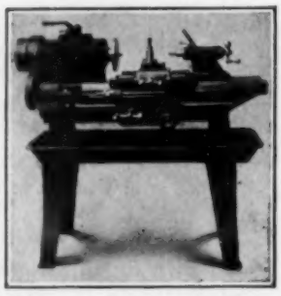
Clip, paste on 3 x 5-in. cards and file as desired

Lathe, Gun-Boring, "Ricon"
Riter-Conley Co., Pittsburgh, Penn.
"American Machinist," Aug. 29, 1918



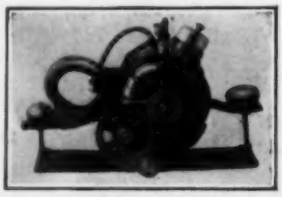
Particularly for drilling guns from the solid, but it can be used for finish-boring work. Made in lengths up to 60 ft. and with two, four or eight speeds as desired. On boring work both the work and the drill revolve, the drill speed normally being in a ratio of 2:1 to the speed of the work. Swing over shears, 26 in.; length of each head, 13 ft.; weight with 60-ft. bed, 40,000 lb.

Lathe, "Short Cut" 12-in.
Ogden R. Adams, 159-161 St. Paul St., Rochester, N. Y.
"American Machinist," Aug. 29, 1918



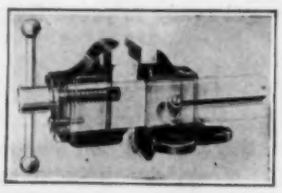
Swing over bed, 12¼ in.; swing over carriage, 7 in.; swing between centers, 19 in.; length of bed, 48 in.; hole through spindle, 1 1/16 in.; maximum capacity of wire chuck, ⅞ in.; front bearing, 2 in. in diameter by 2⅞ in. long; rear bearing, 1⅞ in. in diameter by 2 in. long; spindle nose, 2 in. in diameter, threaded 6 pitch and bored for No. 4 Morse taper; feeds, 0.007, 0.015 and 0.020 in. per spindle revolution without changing gears, three more changes being available by means of change gears; length of carriage, 18 in.; width of cross-slide, 7 in.; speeds, six, 23 to 374 r.p.m., arranged in geometrical progression; size of tool, ⅝ by 1¼ in.; tailstock spindle, 1¼ x 7 in.; net weight, 1300 lb.

Plane, Motor-Driven Hand
Universal Planer Co., 16 Exchange Pl., Room 6, New York City.
"American Machinist," Sept. 5, 1918



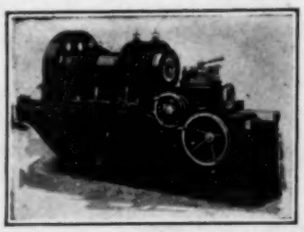
Designed primarily to plane the sides of wooden ships, but is just as applicable in any case where large surfaces have to be smoothed over. Rotary cutting blades are used, these being driven at a high speed by an electric motor incorporated in the machine. The thickness of the shavings is adjusted by means of setscrews, and provision is also made for bending the bottom of the plane so that either concave or convex work can be done. It is stated that the knives can be removed and replaced in less than 5 min. and that hard or soft wood can be cut with equal ease and at any angle to the grain. Motors are furnished to suit any current available, the connection being to the ordinary lamp socket, the maximum power required being 800 watts. The width of cut taken is 4 in., and it is claimed that one machine can do as much work as 20 men with jack planes.

Vise, Quick-Acting
The Velox Vise Co., Inc., Lowville, N. Y.
"American Machinist," Sept. 5, 1918



The bar, which in this vise is made of steel, can be slipped back and forth in the body, while the screw is used only for tightening the front jaw on the work. By lifting slightly on the screw head the bar may be slipped forward or backward until the jaws are approximately the right distance apart to accommodate the work when a slight turn of the screw tightens the work. The steel bar is held by means of two screws, one at each side, which bear in slots cut in the sides of the bar. Another feature claimed is that the narrow bar gives more clearance in the throat of the vise, which is advantageous where deep work is handled. The vise is made in two styles, heavy and light, nine sizes to each style, varying from 2-in. jaws with an opening of 4 in. and weight of 10 lb. to 6-in. jaws with an opening of 11 in. and a weight of 130 lb.

Lathes, Shell, "Bryant"
R. M. Eddy Foundry Co., Chicago, Ill.
"American Machinist," Aug. 29, 1918

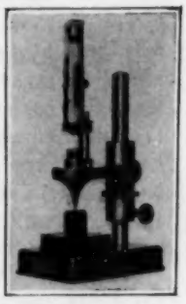


This company is manufacturing a line of shell lathes that are of very similar construction except for the carriages, which are arranged as required for various operations. The illustration shows the Type 6 FEF, which is for finish-facing to weight and for grooving the base end of projectiles. Type 6 BT is for rough and finish turning projectile bands; Type 6 TT is for rough and finish turning projectile taper for casing and Type 6 BG is for grooving, waving and undercutting for bands. Swing, 28 in.; front spindle bearing 12½ x 14 in.; rear spindle bearing, 8 x 10 in.; width of carriage guide, 7½ in.; area of carriage bearing, 309 sq.in.; length of carriage guide, 30 in.; driving clutch pulley, 18 x 6 in.; standard gearing ratio, 7:1; pitch of gearing, 4 in.; floor space required, 3 ft. by 8 ft. 6 in.; approximate weight, 9000 lb.

Presses, Power
Ferracute Machine Co., Bridgeton, N. J.
"American Machinist," Sept. 5, 1918

The illustration shows the E23 press, which is the third size of a series of six. Specifications for this machine are as follows: Size of bed, 25 in. right to left and 22 in. front to back; width between columns 26 in.; diameter of flywheel, 35 in.; face of flywheel, 6 in.; weight of flywheel, 750 lb.; diameter of shaft bearings, 3¼ in.; diameter of crank bearing, 4½ in.; stroke, 2 in.; ram adjustment, 3 in.; height from bed to ram at top of stroke and adjustment, 10 in.; weight, 3900 lb.; ram pressure, 35 tons.

Gage, Precision Fluid
Coats Machinery Co., Land Title Bldg., Philadelphia, Penn.
"American Machinist," Sept. 5, 1918



This device is for inspection work and is a comparator rather than an actual measuring instrument. Dimensions of base, 7½ in. front to back, 5½ in. wide; size of tool-steel anvil, 3 x 3 in.; weight without slanting base, 16 lb.; weight with slanting base, 18 lb.; height of column, 12 in.; total height of gage with testing head in upper position, 19½ in.; capacity, rounds from ¼ to 6½ in.; magnification, 800 to 1250 as desired; length of scale on indicating tube, 2 in.; diameter of column, 1 in.

Jig, Drilling
M. B. Hill Manufacturing Co., 10 Eden St., Worcester, Mass.
"American Machinist," Sept. 5, 1918

For drilling short cyclindrical work, one side being open so that the chips can be readily brushed out. Is provided with an adjustable stop and has a vertically sliding arm in which the proper drill jig may be inserted. This arm is also provided with a knurled-head thumbscrew for holding the work securely in place until the drill strikes it. The jig can also be arranged for drilling balls if this work is handled. The dimensions of the base are 2 x 4 in.; the capacity is stock up to 1¼ in. in diameter, and the weight is 3 lb. It will be noticed that the device is provided with slots so that it can be bolted to a machine.

Patented Aug. 20, 1918

Personals

L. J. Voyer has been made general manager of sales of the Liberty Steel Co., Warren, Ohio.

J. C. Axelson has been promoted to the position of general manager of the Axelson Machine Co., Los Angeles, Calif.

Thomas Stratford of Philadelphia has been made general manager of the Nu-Ex Fire Appliance Co., Columbus, Ohio.

J. O. Persons, formerly works engineer of the Remington Arms Co., Bridgeport, Conn., is now general manager of Bayles' Shipyard, Port Jefferson, N. Y.

E. C. Kerrigan is now general purchasing agent of the Great Lakes Engineering Works, Detroit, Mich. He succeeds **James S. Keightly,** who has resigned.

Dwight D. Miller, formerly with the Society for Electrical Development, is now in charge of the new office of the Electric Furnace Co., 15 Park Row, New York.

R. Hueber has resigned as export manager of the Latshaw Steel and Metal Products Corporation and is now secretary of the Steel Industries Corporation, New York.

T. H. Harvey has been appointed works manager of the Ohio Steel Foundry Co., Springfield, Ohio. He was formerly connected with the Pelton Steel Co., Milwaukee, Wis.

R. W. Davis is now connected with the sales organization of the Cleveland Milling Machine Co. and is in charge of the Detroit territory with offices at 705 Dime Bank Building, Detroit, Mich.

J. J. Trefz of Owensboro, Ky., is now general manager of the Southern Foundry Co., Owensboro. Mr. Trefz was formerly superintendent of the Anglo-American Mill Co., manufacturer of milling machinery.

Walter A. Riding of the Porter-Cable Machine Co., Syracuse, N. Y., has been appointed chairman of the machinery and mechine-shop products section of the local section of the bureau of resources and conversion of the War Industries Board.

F. W. Shumard, equipment and production engineer at the Utica, N. Y., plant of the Savage Arms Corporation, has secured a similar position in Washington, D. C., in the Maintenance Division of the Motor Transport Corps.

Capt. S. E. Blunt, U. S. A., has been appointed employment supervisor and will work in conjunction with the commanding officers of the several arsenals and other ordnance establishments to secure the necessary personnel for their efficient operation.

W. J. Garrity, recently of the New York office of the L. S. Starrett Co., has sailed for France to become sales manager of the small-tool department of Young, Corley & Dolan, Inc., 7 Rue Meyerbeer, Paris, France. This company has an office at 115 Broadway, N. Y.

James Taylor has resigned as general manager and treasurer of the Latshaw Steel and Metal Corporation, New York, and treasurer of the Pennsylvania Shafting Co., Spring City, Penn., and is now connected with the Steel Industries Corporation, New York, as its treasurer.

Louis J. Horowitz, formerly president of the Thompson-Starrett Construction Co., New York, has been appointed special assistant to the Chief of Ordnance in charge of tanks. In this capacity Mr. Horowitz will have authority to decide all questions pertaining to the engineering, manufacturing and inspection of tanks.

H. E. Henry has been appointed general sales manager of the Fulflo Pump Co., Manchester, Ohio, succeeding **A. N. Martin,** who has taken a position with the Pyle National Co., Chicago, Ill. Mr. Henry has been associated with the above firm as purchasing agent ever since the business was established. He will continue to act as purchasing agent for the present.

Roger P. Redier has been appointed general sales manager of the Allied Machinery Co. of America, 120 Broadway, New York, with headquarters in Paris, France. Mr. Redier has had considerable experience in selling American machinery throughout continental Europe. He is now in the United States visiting the company's factories and expects to return to France this fall.

Richard P. Tell has been appointed chairman of the Wisconsin Division, Region 17, of the War Industries Board to fill the vacancy caused by the resignation of **August H. Vogel** of Milwaukee, who found it impossible to serve. Mr. Tell is president and general manager of the National Brake and Electric Co. and president of the Milwaukee Metal Trades and Founders' Association.

Brig. Gen. John T. Thompson, U. S. A. retired, in addition to his duties as Director of Arsenals and Advisory Engineer, has been made Director of Ordnance Training. In this position he will determine the type of training to be given the commissioned, enlisted and civilian personnel of the Ordnance Department and will make provisions for this training. General Thompson will also give final approval to all subjects to be taught, character and scope of examinations, and will establish a system of inspection of all the schools operated by the Ordnance Department.

Business Items

The Lakewood Engineering Co., Cleveland, Ohio, has opened new offices in the Lumber Exchange Building, Chicago, Ill.

The Halcomb Steel Co. has opened an office at Room 702, Connecticut Mutual Life Insurance Building, 36 Pearl St., Hartford, Conn. This office will be in charge of E. L. Reed.

The Chas. T. Topping Machinery Co. has merged its interests with the Pittsburgh office of the Lakewood Engineering Co., Cleveland, Ohio, manufacturer of construction plants and industrial haulage.

The E. M. Dart Manufacturing Co., makers of pipe unions, is now located in its new building at Thurbers Ave., Eddy and Blundell Sts., Providence, R. I. The office is located at 134 Thurbers Ave.

Sayegusa & Co., machinery merchants, Osaka, Japan, want to make agency arrangements with the makers of the following equipment: Taper and straight twist drills, taps, reamers, gear and milling cutters, die stocks, chain blocks, hacksaws, circular and bandsaw blades, files, electric drills and grinders, emery wheels and whiting stones, lathe and drill chucks, sleeves, thickness gages, micrometers, dies and screw plates, lathes, drilling, shaping, planing, milling and grinding machines, pneumatic drills and riveting and caulking hammers. It is willing to pay cash against documents, and would like catalogs and code words in order that cabled orders can be sent. It also wants estimates on any other machine tool that would be prospective sales to iron works and shipyards.

Trade Catalogs

Circular Metal Cutting Saws. E. C. Atkins & Co., Inc., Indianapolis, Ind. Booklet. Pp. 16; 4¾ x 7½ in. Alternate pages of this booklet show illustrations and give a description of circular metal-cutting saws.

Hacksaw Chart and Price List. E. C. Atkins & Co., Inc., Indianapolis, Ind. Booklet. Pp. 8; 3½ x 6 in. This booklet gives the name, number, size and prices of hacksaws, together with information concerning saws best adapted for various purposes.

Metal Cutting Machines. E. C. Atkins & Co., Inc., Indianapolis, Ind. Catalog. Pp. 16; 9 x 6 in. This is a catalog illustrating and describing the Atkins Kwik-Kut metal-cutting machines. Various parts of this machine are illustrated and explained. Prices, terms and specifications are also given.

Iron Clad Solenoids. Cutler-Hammer Manufacturing Co., Milwaukee, Wis. Booklet "F." Pp. 4; 8½ x 11 in. This booklet describes the construction of these solenoids, which are adapted for operating brakes used in connection with crane, elevator and hoist motors. Four sizes are listed, and the stroke, gross pull, dimensions, weights and other data are given.

Grinding Wheels and Machinery. L. Best Co., 75 Barclay St., N. Y. Catalog. Pp. 72; 6 x 9 in. This catalog gives prices, terms, illustrations and a description of grinding machinery, emery wheels, diamond tools, polishers' supplies, polishing machinery, rubbing bricks, countershafts, respirators, wire brushes, dressers and many other articles. A trade-discount sheet is inclosed.

New Publications

Fundamentals of Mechanical Drawing—By Richard Shelton Kirby, C.E., Assistant Professor of Drawing and Descriptive Geometry, Sheffield Scientific School, Yale University. Eighty-three 10 x 7 in. pages and index; 24 plates. Published by John Wiley & Sons, Inc., New York.

This book is intended for the use in elementary courses of drawing and aims to give the principles of the subject without encroaching on the subjects of descriptive geometry, machine design or other advanced drawing. Emphasis is laid on correct habits of work, graphical curve construction, orthographic projection, isometric drawing and technic. The chapter headings are as follows: Chapter 1, Selection and Use of Instruments; Chapter II, Geometric Constructions; Chapter III, Orthographic Projections; Chapter IV, Isometric Drawing and Similar Systems of Projection; Chapter V, Lettering and Dimensioning; Chapter VI, Working Drawings; Chapter VII, Perspective; Problems.

Forthcoming Meetings

The American Foundrymen's Association, the Iron and Steel Section of the American Institute of Mining Engineers, the Institute of Metals Division of the American Institute of Mining Engineers and the American Malleable Castings Association will hold a joint meeting at Milwaukee during the week of Oct. 7, 1918. There will be a large number of manufacturers represented at the exhibition, to be held in the Milwaukee Auditorium, and many papers will be read. Theodore O. Vilter, president of the Vilter Manufacturing Co., is chairman of the general committee.

American Gear Manufacturers' Association will hold its semi-annual meeting at the Onondaga Hotel, Syracuse, N. Y., Sept. 19, 20 and 21.

The American Society of Mechanical Engineers will hold a meeting of its mid-western sections, including Cincinnati, St. Louis, Chicago, Milwaukee, Detroit, Birmingham and Indianapolis in the last mentioned city on Oct. 25 and 26. It is expected that the Indiana Engineering Society and the Indianapolis Lafayette section of the American Institute of Electrical Engineers will join in making the arrangements.

American Society of Mechanical Engineers. Monthly meeting second Tuesday. Calvin W. Rice, secretary, 29 West 39th St., New York City.

Boston Branch National Metal Trades' Association. Monthly meeting on first Wednesday of each month. Young's Hotel. Donald H. C. Tullock, Jr., secretary. Room 41, 166 Devonshire St., Boston, Mass.

Engineers' Society of Western Pennsylvania. Monthly meeting, third Tuesday; section meeting, first Tuesday. Elmer K. Hiles, secretary, Oliver Building, Pittsburgh, Penn.

The National Safety Council will hold its seventh annual safety congress at the Hotel Statler, St. Louis, Mo., on Sept. 16 to 20. A number of papers will be presented on various subjects relating to safety and prominent speakers will deliver addresses. Section meetings will be held for discussing safety problems in various industries and an informal dinner will be given on Wednesday evening when a five-minute address by long-distance telephone by President Wilson will be delivered through the courtesy of the Southwestern Bell Telephone Co.

New England Foundrymen's Association. Regular meeting, second Wednesday of each month. Exchange Club, Boston, Mass. Fred F. Stockwell, 205 Broadway, Cambridgeport, Mass.

Philadelphia Foundrymen's Association. Meetings first Wednesday of each month. Manufacturers' Club, Philadelphia, Penn. Howard Evans, secretary, Pier 45, North Philadelphia, Penn.

Providence Engineering Society. Monthly meeting fourth Wednesday of each month. A. E. Thornley, corresponding secretary, P. O. Box 796, Providence, R. I.

Rochester Society of Technical Draftsmen. Monthly meeting, last Thursday. O. L. Angevine, Jr., secretary, 857 Genesee St., Rochester, N. Y.

Superintendents' and Foremen's Club of Cleveland. Monthly meeting, third Saturday. Philip Frankel, secretary, 310 New England Building, Cleveland, Ohio.

Technical League of America. Regular meeting, second Friday of each month. Oscar S. Teale, secretary, 240 Broadway, New York City.

Western Society of Engineers, Chicago, Ill. Regular meetings, first, second, third and fourth Mondays of each month, except July and August. Edgar S. Nethercut, secretary, 1735 Monadnock Block, Chicago, Ill.

WEEKLY PRICE GUIDE OF

IRON AND STEEL

The Government Schedule of steel prices went into effect Sept. 24. Pig iron was set at $33 per ton; pig iron differentials were announced by the American Iron and Steel Institute on Nov. 3. Washington announced sheet and pipe prices on Nov. 5. Warehouse prices have been revised, as shown, by agreement between the War Industries Board and the warehouses; new schedule in effect Nov. 15. Effective Apr. 1, the price of basic iron was fixed at $32, and standard Bessemer at $35.20 at Valley furnace, prices of other irons remaining the same as last quarter.

PIG IRON—Quotations per ton were current as follows at the points and dates indicated:

	Current	One Month Ago	One Year Ago
No. 2 Southern Foundry, Birmingham..	$33.00	$33.00	$47.00
No. 2X, furnace, New York	34.00	34.00	53.00
No. 2, Chicago	33.00	33.00	55.00
Bessemer, Pittsburgh	36.60	36.60	52.95
*Basic, Valley, furnace	32.00	32.00	48.95
No. 2X, furnace, Philadelphia	34.40	34.40	53.00
*No. 2, Valley, furnace	33.00	33.00	53.00
No. 2 Southern Cincinnati	36.60	36.60	49.90
Basic, Eastern Pennsylvania	32.90	32.90	50.00

*Delivered Pittsburgh $1.40 more.

STEEL SHAPES—The following base prices per 100 lb. are for structural shapes 3 in. by ¼ in. and larger, and plates ¼ in. and heavier, from jobbers' warehouses at the cities named:

	New York			Cleveland		Chicago	
	Current	One Month Ago	One Year Ago	Current	One Year Ago	Current	One Year Ago
Structural shapes	$4.245	$4.245	$5.25	$4.17	$5.00	$4.27	$5.00
Soft steel bars	4.145	4.145	5.00	4.07	4.50	4.17	4.50
Soft steel bar shapes	4.145	4.145	5.00	4.17	4.50	4.17	4.50
Soft steel bands	4.995	4.995	....	....	....	....	....
Plates, ¼ to 1 in. thick	4.495	4.495	10.00	4.42	7.00	4.25	9.00

BAR IRON—Prices per 100 lb. at the places named are as follows:

	Current	One Year Ago
Pittsburgh, mill	$3.50	$4.75
Warehouse, New York	4.75	4.75
Warehouse, Cleveland	4.10	4.95
Warehouse, Chicago	4.10	4.50

STEEL SHEETS—The following are the prices in cents per pound from jobbers' warehouse at the cities named:

	Pittsburgh, Mill, in Carloads	New York			Cleveland		Chicago	
		Current	One Month Ago	One Year Ago	Current	One Year Ago	Current	One Year Ago
*No. 28 black	5.00	6.495	6.495	10.50	6.42	9.00	6.52	10.00
*No. 26 black	4.90	6.395	6.395	10.40	6.32	8.90	6.42	9.90
*Nos. 22 and 24 black	4.85	6.345	6.345	10.35	6.27	8.85	6.37	9.85
Nos. 18 and 20 black	4.80	6.295	6.295	10.30	6.22	9.20	6.32	9.80
No. 16 blue annealed	4.45	5.695	5.695	10.20	5.62	9.20	5.72	10.20
No. 14 blue annealed	4.35	5.595	5.595	10.10	5.52	9.10	5.62	10.10
No. 10 blue annealed	4.25	5.495	5.495	10.00	5.42	9.00	5.52	10.00
*No. 28 galvanized	6.25	7.745	7.745	12.00	7.67	10.75	7.77	11.50
*No. 26 galvanized	5.95	7.445	7.445	11.70	7.37	10.45	7.32	11.20
No. 24 galvanized	5.80	7.295	7.295	11.55	7.22	10.30	7.47	11.05

*For painted corrugated sheets add 30c. per 100 lb. for 25 to 28 gage; 25c. for 19 to 24 gages; for galvanized corrugated sheets add 5c., all gages.

COLD DRAWN STEEL SHAFTING—From warehouse to consumers requiring at least 1000 lb. of a size (smaller quantities take the standard extras) the following discounts hold:

	Current	One Year Ago
New York	List plus 12%	List plus 25%
Cleveland	List plus 12%	List plus 10%
Chicago	List plus 13%	List plus 10%

DRILL RODS—Discounts from list price are as follows at the places named:

	Extra	Standard
New York	35%	40%
Cleveland	20.00	14.30
Chicago	35%	40%

SWEDISH (NORWAY) IRON—The average price per 100 lb., in ton lots is:

	Current	One Year Ago
New York	$15.50–19	$14.00
Cleveland	20.00	15.00
Chicago	19.00	13.00

In coils an advance of 50c. usually is charged.

Note—Stock very scarce generally.

WELDING MATERIAL (SWEDISH)—Prices are as follows in cents per pound f.o.b. New York, in 100-lb. lots and over:

Welding Wire*

⅜, ½, ⅝, ¾, ⅞, 1, 1⅛, 1¼, 1⅜, 1½, 1¾, 2, 2¼, 2½, 2¾, 3, 3¼, 3½, 3¾, 4, 4¼, 4½, 4¾, 5, 5¼, 5½, 5¾, 6, 6¼, 6½, 6¾, 7, 7¼, 7½, 7¾, 8, 8¼, 8½, 8¾, 9, 9¼, 9½, 9¾, 10, 10¼, 10½, 10¾, 11, 11¼,

SHOP MATERIALS AND SUPPLIES

OLD METALS—The following are the dealers' purchasing prices in cents per pound:

	New York Current 1918	New York One Yr. Ago	Cleveland Current 1918	Cleveland One Yr. Ago	Chicago
Copper, heavy and crucible	24.00	24.00	24.00	24.75	23.00
Copper, heavy and wire	22.50	23.00	23.50	24.00	23.25
Copper, light and bottoms	20.50	21.00	21.50	22.00	21.50
Lead, heavy	7.25	8.00	.....	8.00	7.35
Lead, tea	5.50	6.75	7.50	6.00	6.50
Brass, heavy	14.75	15.25	16.00	17.00	23.50
Brass, light	11.00	11.50	12.50	13.00	12.85
No. 1 yellow brass turnings	13.75	16.25	14.00	16.00	14.00
Zinc	6.50	6.00	6.50	6.00	6.50

ALUMINUM—The following prices are from warehouse at places named:

	New York	Cleveland	Chicago
No. 1 aluminum, guaranteed over 99% pure, in ingots for remelting (1-15 ton lots), per lb.	33.20c.	32.20c.	33½c.

This is the Government price for lots of from 1 to 14 tons.

COPPER BARS from warehouse sell as follows in cents per pound, for ton lots and over:

	Current	One Year Ago
New York	32.00	41.00
Chicago	38.00	41.00
Cleveland	36.50	39.00

BABBITT METAL—Warehouse price per pound:

	New York Current	New York One Year Ago	Cleveland Current	Cleveland One Year Ago	Chicago Current	Chicago One Year Ago
Best grade	110.00	70.00	98.00	69.75	96.00	70.00
Commercial	50.00	40.00	23.00	24.50	25.00	25.00

SHOP SUPPLIES

NUTS—From warehouse at the places named, on fair-sized orders, the following amount is deducted from list:

	New York Current	New York One Year Ago	Cleveland Current	Cleveland One Year Ago	Chicago Current	Chicago One Year Ago
Hot pressed square	$2.50*	List	$1.25	$1.65	$1.05	$2.50
Hot pressed hexagon	2.50*	List	1.05	1.50	.85	2.50
Cold punched hexagon	2.50*	List	.75	1.25	1.00	1.50
Cold punched square	2.50*	List	.75	1.25	1.00	1.50

* List plus.

Semifinished nuts sell at the following discounts from list price:

	Current	One Year Ago
New York	40%	50%
Chicago	50%	45%
Cleveland	50 + 10%	50%

MACHINE BOLTS—Warehouse discounts in the following cities:

	New York	Cleveland	Chicago
⅝ by 4 in. and smaller	30%	40+10%	37%
Larger and longer up to 1 in. by 30 in.	15%	20+ 5%	25—5%

WASHERS—From warehouses at the places named the following amount is deducted from list price:

For wrought-iron washers:
New York ..... $2.50 Cleveland ..... $1.00 Chicago $2.50

For cast-iron washers the base price per 100 lb. is as follows:
New York ..... $5.00 Cleveland ..... $4.00 Chicago $3.50

CARRIAGE BOLTS—From warehouses at the places named the following discounts from list are in effect:

	New York	Cleveland	Chicago
⅝ by 4 in. and smaller	30%	45%	37%
Larger and longer up to 1 in. by 30 in.	15%	20+5%	25—5%

COPPER RIVETS AND BURS sell at the following rate from warehouse:

	Rivets Current	Rivets One Year Ago	Burs Current	Burs One Year Ago
Cleveland	List plus 10%	List plus 10%	List plus 10%	List plus 10%
Chicago	List price	List price	List plus 20%	List price
New York	20% from list	List plus 10%	List plus 20%	10-2½% from list

RIVETS—The following quotations are allowed for fair-sized orders from warehouse:

	New York	Cleveland	Chicago
Steel ⅝ and smaller	30%	45—5%	40%
Tinned	30%	45—5%	40%

Button heads, ¾, ⅞, 1 in. diameter by 2 in. to 5 in. sell as follows per 100 lb.
New York..$5.65 Cleveland..$5.15 Chicago..$5.67 Pittsburgh..$4.65

Coneheads, same sizes:
New York..$5.75 Cleveland..$5.25 Chicago..$5.77 Pittsburgh..$4.75

MISCELLANEOUS

SEAMLESS DRAWN TUBING—The base price in cents per pound from warehouse in 100-lb. lots is as follows:

	New York	Cleveland	Chicago
Copper	49.00	42.50	39.50
Brass	40.00	40.00	44.00

For immediate stock shipment 3c. is usually added. The prices of course vary with the quantity purchased. For lots of less than 100 lb. but not less than 75 lb., the advance is 1c.; for lots of less than 75 lb. but not less than 50 lb., the advance is 2½c. over base (100-lb. lots); for less than 50 lb. but not less than 25 lb., 5c. should be added to the base price; and for quantities under 25 lb. the increase above base is 10c.

TIN PLATES—Warehouse prices per box:

Coke tin plate, 14 x 20:

	Cleveland Current	Cleveland One Yr. Ago	Chicago Current	Chicago One Yr. Ago
100 lb.	$10.00	$12.00	$10.60	$11.75
I. C. 107 lb.	10.15	12.17½	10.70	11.90

Terne plate, 20 x 28:

Base Weight	Net Weight	Coating				
100 lb.	200	3	18.95	18.95	19.10	17.90
I. C.	214	8	19.25	19.25	19.40	18.25
I. C.	270	8	21.75	21.75	21.40	20.35
I. C.	218	12	21.75	21.75	22.60	19.25
I. C.	221	15	22.50	22.50	22.10	19.50
I. C.	226	30	23.25	23.25	22.60	20.50
I. C.	231	25	24.50	24.50	23.10	21.30
I. C.	236	30	25.75	25.75	23.60	22.25
I. C.	241	35	26.75	26.75	25.10	23.25
I. C.	246	40	28.00	28.00	25.60	24.55

NOTE—New York prices furnished on application to dealers. Price varies according to whether the plates are wanted for work essential to the war or for nonessential work.

COTTON WASTE—The following prices are in cents per pound:

	New York Current	New York One Year Ago	Cleveland	Chicago
White	11.00 to 13.00	13.00	16.50	12.00 to 16.50
Colored mixed	8.50 to 12.00	12.00	13.00	11.50 to 14.00

WIPING CLOTHS—Jobbers' price per 1000 is as follows:

	13¼ x 12¾	13¼ x 20½
Cleveland	52.00	58.00
Chicago	48.00	50.00

SAL SODA sells as follows per 100 lb.:

	Current	One Month Ago	One Year Ago
New York	$1.75	$1.75	$1.75
Philadelphia	1.75	1.75	1.75
Cleveland	2.40	2.40	2.10
Chicago	2.00	2.00	2.00

ROLL SULPHUR in 360-lb. bbl sells as follows per 100 lb.:

	Current	One Month Ago	One Year Ago
New York	$4.30	$4.30	$4.30
Cleveland	4.60	4.60	4.50
Chicago	4.00	4.00	3.80

COKE—The following are prices per net ton at ovens, Connellsville, and cover the past four weeks:

	Sept. 12	Sept. 5	Aug. 29	Aug. 22	Aug. 15
BPrompt furnace	$6.00	$6.00	$6.00	$6.00	$6.00
Prompt foundry	7.00	7.00	7.00	7.00	7.00

FIRE CLAY—The following prices prevail:

		Current
Chicago	450-lb. bbl.	$2.50
Cleveland	375-lb. bag	2.50

LINSEED OIL—These prices are per gallon:

	New York Current	New York One Year Ago	Cleveland Current	Cleveland One Year Ago	Chicago Current	Chicago One Yr. Ago
Raw in barrels	$1.90	$1.23	$2.10	$1.30	$2.05	$1.27
5-gal. cans	2.00	1.63	2.25	1.40	2.25	1.37

WHITE AND RED LEAD in 500-lb. lots sells as follows in cents per pound:

	Red Current Dry	Red Current In Oil	Red 1 Year Ago Dry	Red 1 Year Ago In Oil	White Current Dry and In Oil	White 1 Year Ago Dry and In Oil
100-lb. keg	14.00	14.50	12.25	12.50	14.00	12.50
25 and 50-lb. kegs	14.25	14.75	12.50	12.75	14.25	12.25
12½-lb. keg	14.50	15.00	12.75	13.00	14.50	12.50
5-lb. cans	——	——	14.25	14.00	16.00	14.50
1-lb. cans	——	——	14.25	14.50	17.00	14.50

NEW *and* ENLARGED SHOPS

Consult the Buying Section when in need of machinery or supplies

WASHINGTON, D. C.

The Navy aims to give information regarding its purchases to all manufacturers known to be in a position to supply its demand. Owing to the need of prompt action in the cases of all machine tools hereinafter listed, the Navy cannot arrange to permit a postponement of the opening of bids if the manufacturers are able to secure bidding forms and submit their bids prior to date fixed for opening.

In case time does not permit this, it will be appreciated if any manufacturer not receiving information directly regarding these purchases will notify the Purchasing Division, Bureau of Supplies & Accounts, Navy Department, Washington, D. C., in order that the firm's name may be properly listed for all future purchases.

The Bureau of Supplies and Accounts, Navy Department, will receive bids for furnishing machines and machine tools, as follows:

Sept. 20—Schedule No. 5657½, punching press, delivery Philadelphia, Penn.

Schedule No. 5693½, 5 machine tools, delivery South Charleston, W. Va.

Schedule No. 5701½, 1 shaper, delivery Philadelphia, Penn.

Schedule No. 5795½, sole cutting machine, delivery Ft. Mifflin, Penn.

Schedule No. 5801½, 2 steam towing machines, delivery Boston, Mass.

The Bureau of Supplies and Accounts, Navy Department, received bids for furnishing machines and machine tools, as follows:

Schedule No. 5369½, Class 138, universal milling machine; Class 139, 1 motor driven miller, 1 vertical milling attachment and three arbors, ¾ in. diameter; delivery Pensacola, Fla., from Browne & Sharpe Manufacturing Co., Promenade St., Providence, R. I. (138) $2620; Fairbanks Co., Colorado Bldg., Wash., D. C., (139) $1620; Kemp Machinery Co., 223 North Calvert St., Baltimore, Md., (139) $679.

Schedule No. 5507½, Class 153, electric welders, from Federal Machine and Welder Co., Philadelphia, Penn., $2525; Taylor Welder Co., Warren, Ohio, $4050.

Schedule No. 5414½, Class 163, four 8 in., four 19 in. and two 26 in. arbor presses, delivery Wash., D. C., from E. Bartlett Bros., 41 Crown St., Nashua, N. H., $960; W. F. Davis Machine Tool Co., 945 Pennsylvania Ave., Wash., D. C., $1009, alternate $1025; Dale Brewster Machine Co., 30 Church St., New York City, $1187; Kemp Machinery Co., 223 North Calvert St., Baltimore, Md., $987; alternate $997; Manning, Maxwell & Moore, 119 West 40th St., New York City, $1104, alternate $1112; Patterson, Gottfried & Hunter, Inc., 211 Center St., New York City, $1080; D. Nast Machinery Co., Bourse Bldg., Philadelphia, Penn., $354, alternate $344; E. L. Stringer, Baltimore, Md., $649.

Schedule No. 5413½, Class 164, tool grinders, delivery Wash., D. C., from W. F. Davis Machine Tool Co., 945 Pennsylvania Ave., Wash., D. C., $49; Hisey Wolf Co., Colerain and Marshall St., Cincinnati, Ohio, $70; Manning, Maxwell & Moore, 119 West 40th St., New York City, $46; D. Nast Machine Co., Bourse Bldg., Philadelphia, Penn., $48; Patterson, Gottfried & Hunter, Inc., 211 Center St., New York City, $55, alternate, $80; J. Weeks Machine Co., 1270 Broadway, New York City, $69; Wisconsin Electric Co., 16th and Junction Ave., Racine, Wis., $50; Stow Manufacturing Co., 445 State St., Binghamton, N. Y., $55, alternate $65.

Schedule No. 5570½, Class 202, locomotive, delivery Lee Hall, Va., from Baldwin Locomotive Works, Broad and Spring Grove St., Philadelphia, Penn., $11,450; Climax Manufacturing Co., Corry, Penn., $11,800; Glover Machine Works, Marietta, Ga., $9300; H. K. Porter Co., Union Bank Bldg., Pittsburg, Penn., $11,375; Vulcan Iron Works, Wilkes Barre, Penn., $12,000, alternate $12,600 f.o.b.

Schedule No. 5589½, Class 301, drop forgings, delivery East and West Navy Yards, from Acme Harvesting Machine Co., South Bartonville, (Peoria) Ill.; $26,045; Columbus Bolt Works, 160 West Randolph St., Columbus, Ohio, $11,480, part bid; Keystone Forging Co., Northumberland, Penn., $6660 part bid; Michigan Bolt and Nut Works, foot of Meldrum St., Detroit, Mich., $9325 part bid; Oliver Iron Steel Co., 10th and Murich St., Pittsburg, Penn., $203,473, part bid; Page-Storns Drop Forge Co., Chicopee, Mass., $45,375, part bid; Richmond Forging Corporation, Richmond, Va., $162,720, part bid; Whitman & Barnes Manufacturing Co., West Pullman, (Chicago), Ill., $237,093; part bid; D. Wilcox Manufacturing Co., Mechanicsburg, Penn., $375,660; Endicott Forging and Manufacturing Co., Endicott, N. Y., $37,810, part bid; Belden Machine Co., Tyron St., New Haven, Conn., $24,350 part bid; Benton Harbor Malleable Foundry Co., Benton Harbor, Mich., $4640 part bid; Cleveland Hardware Co., Lakeside and East 45th St., Cleveland, Ohio, $32,048, part bid; Clucker & Hixon Co., 256 Broadway, New York City, $30,881, part bid.

Schedule No. 5511½, Class 321, milling machine, delivery Norfolk, Va., from Kemp Machinery Co., 223 North Calvert St., Baltimore, Md., $10,550, alternate $9252; Niles, Bement & Pond, 111 Broadway, New York City, $11,065; Sherrit & Stoer, Finance Bldg., Philadelphia, Penn., $9077.

Schedule No. 5477½, Class 323, boring bars; Class 324, shaper, delivery Cape May, N. J., from W. F. Davis Machine Tool Co., 945 Pennsylvania Ave., Wash., D. C., (323) $606, alternate, $732, (324) $935; Fairbanks Co., Colorado Bldg., Wash., D. C., (323) $608; Kemp Machinery Co., 223 North Calvert St., Baltimore, Md., (323) $660, (324) $840; Monarch Machinery Co., Chicago, Ill., (323) $588, (324) $1055; Manning, Maxwell & Moore, 119 West 40th St., New York City, (323) $600, (324) $1135; D. Nast Machinery Co., Bourse Bldg., Philadelphia, Penn., (323) $594, (324) $1015; E. J. Rooskby Co., 434 North 11th St., Philadelphia, Penn., (323) $650; H. B. Underwood Corporation, 1025 Hamilton St., Philadelphia, Penn., (323) $594; Vandyck Churchill Co., Bourse Bldg., Philadelphia, Penn., (323) $650, (324) $1130; Niles, Bement & Pond, 111 Broadway, New York, (324) $1035; W. E. Shipley Machine Co., Widener Bldg., Philedelphia, Penn., (324) $1215; Sherritt & Stoer Co., Finance Bldg., Philadelphia, Penn., (324) $1245; Aumen Machinery Co., 107-9 West Lombard St., Baltimore, Md., (324) $850; Hollingsworth Machine Tool Co., Covington, Ky., (324) $900.

Schedule No. 5573½, Class 208, grinding machine, delivery Wash., D. C., from Kemp Machinery Co., 223 North Calvert St., Baltimore, Md., $11,595.

Schedule No. 5447½, Class 328, lathe, Class 329, drills, delivery Block Island, R. I., from W. F. Davis Machine Tool Co., 945 Pennsylvania Ave., Wash., D. C., (328) $1276, alternate $931, (329) $283; Fairbanks Co., Colorado Bldg., Wash., D. C., (328) $1640, (329) $175, alternate $210; Manning, Maxwell & Moore, 119 West 40th St., New York City, (328) $1379, (329) $185; National Lathe Co., 15 West 2d St., Cincinnati, Ohio, (328) $984; Niles, Bement & Pond, 111 Broadway, New York City, (328) $1230, (329) $220; D. Nast Machine Co., Bourse Bldg., Philadelphia, Penn., (328) $1290, (329) $190; Henry Prentiss, 149 Broadway, New York City, (328) $1334, (329) $197; Rahn Larmon Co., Spring, Grove and Garrard Sts., Cincinnati, Ohio, (328) $1075; P. Smith Manufacturing Co., Sidney, Ohio, (328) $754; South Bend Lathe Co., 423-27 East Madison St., South Bend, Ind., (328) $462; E. Stringer, Baltimore, Md., (328) $994, (329) $133; Sherritt & Stoer Co., Finance Bldg., Philadelphia, Penn., (328) $1299, (329) $155; Canedy-Otto Manufacturing Co., Toll St., Chicago, Ill., (328) $622, (329) $151; Champion Tool Works, Spring Grove St., near Chickering Place, Cincinnati, Ohio, (328) $1306; J. D. Johnson Co., Inc., 139 North 7th St., Philadelphia, Penn., (329) $202; Kemp Machinery Co., Baltimore, Md., (329) $144; Royersford Foundry and Machine Co., 52 North 5th St., Philadelpia, Penn., (329) $130; Silver Manufacturing Co., Salem, Ohio, (329) $130; J. T. Royerson & Son, Chicago, Ill., (329) $140.

Schedule No. 5626½, Class 333, lathe; Class 334, saw; Class 335, circular saw; Class 336, wood jointer; Class 337, disc sander; Class 338, spindle sander; Class 339, drill press; Class 341, bench planer; delivery New London, Conn., from Defiance Machine Works, Defiance, Ohio, (333) $1140; (334) $470; (335) $540; (336) $405; (337) $555; J. A. Fay & Eagan, John and Front St., Cincinnati, Ohio, (333) $552, alternate $829; (334) $304, (335) $404, alternate $958; (336) $364, alternate $558; (337) $383, alternate $458; (338) $438, $446; (341) $214; Hall Brown Woodworking Machine Co., 1913 North Broadway, St. Louis, Mo., (333) $156, part bid; (334) $305, (335) $310, (336) $323, alternate $377; D. Nast Machine Co., Bourse Bldg., Philadelphia, Penn., (333) $340, (334) $160, (335) $190, (336) $255, alternate $270; (337) $120, (339) $204, (341) $78; H. B. Smith Machine Co., Smithville, N. J., (333) $562, (334) $225, (335) $225, alternate $400, (336) $350, (338) $297, $230; W. Davis Machine Tool Co., 945 Pennsylvania Ave., Wash., D. C., (334) $169, (335) $355, (336) $266, (337) $125, (339) $292, (341) $81; Kemp Machinery Co., 223 North Calvert St., Baltimore, Md., (334) $165, (335) $349, (336) $259, (337) $126, (339) $183, (341) $65; Manning, Maxwell & Moore, 119 West 40th St., New York City, (334) $187, (336) $267, (337) $124, (339) $311, (341) $80; Newman Machine Co., Greensboro, N. C., (334) $203, (336) $234, (341) $110; Oliver Machinery Co., 50 Church St., New York City, (334) $260, (335) $670, alternate $570; (336) $335; Silver Manufacturing Co., Salem, Ohio, (334) $136, (335) $215, (339) $127; American Woodworking Machinery Co., 591 Lyell Ave., Rochester, N. Y., (334) $200, (336) $310, (337) $180; Fairbanks Co., Colorado Bldg., Wash., D. C., (334) $200, (335) $212, (336) $300, (339) $210; J. T. Towsley Manufacturing Co., Cincinnati, Ohio, (335) $310, (336) $295; Buffalo Forge Co., 490 Broadway, Buffalo, N. Y., (339) $159.

Schedule No. 5617½, Class 513, hack saw, F. O. B., from Diamond Saw and Stamping Works, 357 7th St., Buffalo, N. Y., $110; Fairbanks Co., Colorado, Bldg., Wash., D. C., $95; Kemp Machinery Co., 223 North Calvert St., Baltimore, Md., $80; Manning, Maxwell & Moore, 119 West 40th St., New York City, $80, alternate $95, alternate $115; D. Nast Machinery Co., Bourse Bldg., Philadelphia, Penn., $78; H. Prentiss Co. 149 Broadway, New York City, $288; Peerless Machine Co., 1615 Racine St., Racine, Wis., $285; Racine Tool & Machine Co., 1439 Junction Ave., Racine, Wis., 243; Sherritt & Stoer Co., Finance Bldg., Philadelphia, Penn., $275; H. G. Thompson & Sons, Chapel and Mill St., New Haven, Conn., $94; Armstrong Blum Manufacturing Co., 337 North San Francisco Ave., Chicago, Il., $49; Aumen Machine Co., 107-9 East Lombard St., Baltimore, Md., $299.